# MUNICIPAL ENGINEERING

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# EDITORIAL

**MUNICIPAL BOND SALES**

The effect of the war upon municipal bond sales last year was very serious, and the amount of bond sales dropped to the minimum of several years, but that condition has now passed, and the demand for high-grade bonds of counties, cities and villages seems to have no limit.

There has been some increase in the rate of interest on such bonds, due doubtless to the difficulty of disposing of them last year and the consequent attempt to make them more attractive to capital, and they are now more popular with many individual investors than railroad, public utility and industrial corporation stocks and bonds. This is true without reference to the stocks of companies having war orders, the latter being used to gamble with rather than for legitimate investment. In November the sales of municipal bonds amounted to $22,608,415, which was $5,000,000 less than in October and over $9,000,000 greater than in November, 1914. The total sales for the eleven months of 1915 ending December 1 were about $30,000,000 greater than in any preceding year of a decade or more and more than $230,000,000 in excess of the average of the preceding nine years.

The prediction made last year on this page is more than fulfilled, and the municipal field during the coming year will be more attractive to those who have constructing and operating machinery and materials usable in the work of improving and operating municipalities, keeping them clean and serving their citizens, than ever before.

Our daily bulletin reports of prospective work, as well as the contracting news pages, reflect this condition. A rather strenuous year, with unsatisfactory financial results to many, is succeeded by a very prosperous year, which bids fair to be the most prosperous that the country, but especially the municipal field, has enjoyed for many a year.

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**PATENTS ON ENGINEERING DESIGNS**

For some time past, but particularly in very recent years, there has been a tendency among applicants for patents, particularly in the engineering field, to extend the definition of invention to cover the ordinary devices used in the designing department and even in the drafting room. Frequent attempts are made also to secure so-called basic patents upon the principles underlying these devices, no matter how well established in common use they may be. Such attempts are unsuccessful if the claims made are too broad, and in those which are successful the application of the principle is usually restricted to some particular material or kind of work to which it may not have been applied heretofore, so that the basic patent is basic in only a limited field.

The courts have not until recently noted or understood the consequences of this tendency, and have sustained more or less completely patents which cover not real inventions, but simply the application of well-known principles to particular problems. On the other hand, some such applications are really so novel, carry the evidences of invention so far, that only the most hypercritical can object to the issue of the patents. The average judge hearing cases involving infringement of patents of these classes finds it difficult to draw the line between real invention and mere drafting room detail. Indeed, the experts find it quite as difficult to make the decision, unless a count of noses is made, as they are lined up on opposite sides according to their ideas of what matters are subject to patent, their knowledge of patent law and practice, their financial and other interests.

Of late, however, the courts have had a tendency to look more closely into the antecedents of a patent, and there have been a number of decisions declaring patents invalid, when the court concluded from the evidence or from its own knowledge that the proper bounds of the definition of the term invention had been overstepped and the patent had been secured simply upon a variation in the application of well-known principles. Not all these decisions are right, because the court is not always well enough informed to be able to make a proper decision, and so some patents are declared invalid which cover real inventions.

This action of the courts reacts upon the Patent Office, and it is becoming increasingly difficult to obtain patents upon mere variations of devices which have no essence of invention. But the Patent Office also is not infallible, and mistakes are made both in issuing and in refusing patents.

In one recent decision the court decides definitely that "the claimant only made application of mere mechanical knowledge and skill, and that what he did is in no sense a demonstration of inventive genius." The court apparently acknowledges the propriety of issuing patents upon the use of reinforcing steel in concrete, which was involved in the suit, as demonstrating real inventive genius, altho he acknowledges that it has always been necessary to make special provision for tensile stresses in certain parts of a truss, girder or arch. But he denies that inventive genius is exercised in the placing of such reinforcement, and that mere mechanical skill is all that is necessary in making such designs. The issue here is definitely stated, and there will be much difference of opinion upon the justice of the court's decision. Advance is made in patent litigation, however, or rather in the prevention of patent litigation, when so definite a statement of the real point at issue can be made by a court, and, since decisions in favor of the same patents have been made in numerous other United States courts, it will now be possible to have this particular case decided upon its individual merits in the court of last resort.

# PELHAM MANOR CONCRETE ROAD

By Charles A. Mullen, New York City.

*This description of the design and the construction of a one-course concrete pavement with a thin bituminous wearing surface is by one of the men engaged in its construction, and gives some very interesting details. The method of making the joint between the two longitudinal sections, into which the pavement was divided in order to keep one side of the road open to traffic, is a special device, and the manner in which the joint carries the traffic will be watched with care, such longitudinal joints being particularly objectionable in concrete pavements. The street railway construction is also worth study and close observation as to its sufficiency under the conditions.*

THE village of Pelham Manor lies just north of the corporate limits of the boro of the Bronx, New York City, on the shores of Long Island Sound. Its western neighbor is the city of Mount Vernon, and to the east lies the city of New Rochelle, also on the Sound. Pelham Manor is a high-class residential community made up of many extensive estates and beautiful residences set in parked plots. There is only one store in the village, the drug store near the Pelham Manor railway station.

There are but three thru traffic ways in Pelham Manor. The Shore Road and the Boston Turnpike both pass thru it on their way east, and Pelhamdale avenue is the only thru cross-road. It leads from the Sound northward to the juncture of Mount Vernon and the other Pelhams.

Two years ago, at a special election, the residents of Pelham Manor voted a bond issue to improve Pelhamdale avenue, then an old macadam highway and in very bad repair. The road was to be paved for its entire length of a mile and a half, beginning opposite the entrance of the New York Athletic Club's home on Travers Island and ending at the extension of Sixth street, Mount Vernon. The northern one-half mile section of Pelhamdale avenue is traversed by the double track main line of the Westchester Electric Railroad Company, and the remainder of the road, to the south of the historic Red Church that stands at the intersection of Boston Turnpike and Pelhamdale avenue, carries the single track branch running past Pelham Manor station and down to the New York Athletic Club grounds.

The village board, after carefully considering the nature of the road and the amount of the bond issue that had been voted, decided to construct a concrete pavement. They retained Mr. Edward F. Campbell, a well-known civil engineer and surveyor, whose office is at New Rochelle, to draw plans and specifications for and supervise the actual construction work.

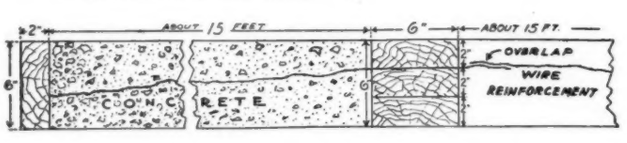
The specifications prepared by Mr. Campbell were very thoro. They called for a uniformly 6-inch one-course concrete pavement, to be composed of one part of portland cement, one and one-half parts of clean, sharp sand, and three parts of what is known commercially as ¾-inch clean trap rock. He then provided for a bituminous top dressing of asphalt or Tarvia to be covered with ⅝-inch clean trap rock chips, this being the smallest commercial size recovered by the Trap Rock Company.

The contract was advertised and finally awarded to Mr. M. J. Leahy, of New Rochelle and New York City, the lowest bidder, at $1.35 per square yard, complete. This price included the removal of the old macadam road surface to an average depth of 6 inches, and the deposit of all the surplus not needed for building shoulders on the village streets within a distance of 2,000 feet, as directed by the engineer; the construction of the 6-inch one-course concrete pavement proper, the laying of the bituminous top dressing about one-quarter inch in thickness, and the shaping of the shoulders with the old macadam material placed alongside for the purpose.

After the village had signed the contract, the street railway company signed a similar contract with Mr. Leahy for the railway area, within, between and two feet outside their tracks. Ground was broken about April 20, and all the work proceeded at once. The street railway company reconstructed all their main line track, and thoroly overhauled their branch line. On the main line, they used a very heavy section 7-inch grooved rail, electrically welding the joints.

The grading was done in the usual way, with a rooter plow drawn by a heavy steam roller, and horses and wagons. The sand and stone were received by boat and hauled an average of two miles in White automobile dump trucks. The stone was furnished by the New York Trap Rock Company, and all the sand used was washed Cow Bay, furnished by the Phoenix Sand and Gravel Company. It was thought that the local bank sand, tho regularly used for foundation work, was not sufficiently clean and sharp for surface work. The portland cement was received in carload lots as used, the engineer being furnished with mill tests by the cement company as each car was shipped.

A Koehring concrete mixer was used, one of their regular road mixers, with skip for loading and boom and bucket discharge. The measuring and loading was by boxes of exact dimensions bolted to wheelbarrow platforms, the front of the box having a sloping side for convenient dumping. Two-by-six-inch spruce side-forms were used, the rail serving for one side. The concrete was mixed fairly wet, and struck with a steel-bound four-by-six timber having handles at each end. There was no curvature in this template, and care was taken to see that it remained perfectly straight. The surface was then finished with a float handled by a man on a bridge in




CROSS-SECTION *of concrete street, showing method of reinforcing joint down the center of the pavement, due to laying one side at a time. It also shows the method of laying the concrete on the first half constructed and location of planks for forms so as to hold the reinforcement in the right place. The pavement has a crown, tho the draftsman has not shown it.*

the usual way, and was broomed as it stiffened to roughen slightly the surface transversely of the road.

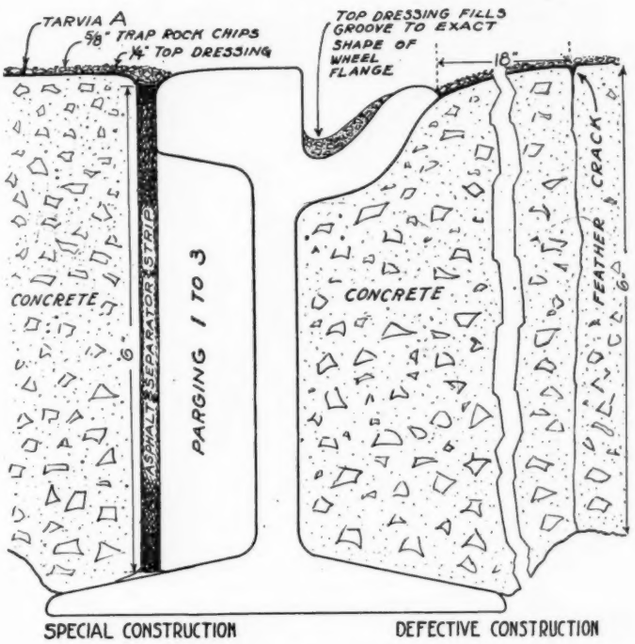
When the entire concrete work was completed, the surface was swept absolutely clean, house brooms being used for the final sweeping. Tarvia A was then applied from high pressure distributers, and the trap-rock chips were applied as a covering. The trap-rock chips had previously been deposited in piles about fifty feet apart along the sides of the road, and were spread upon the tarviated surface by means of wheelbarrows and shovels, which method proved satisfactory. One-third of a gallon of Tarvia A and one-hundredth of a cubic yard of stone chips were used to each square yard of road.

Several interesting features in the construction of this concrete road were the detail of construction at the rails, the reinforcing of a section at the Shore Road, about one hundred feet long, in which there was no car track, and the use of stone chips instead of torpedo gravel for the covering of the bituminous top dressing. The crown of the road was in straight lines with a drop to the sides of one-quarter of an inch to the foot. From the car rail to the side of the road was ten feet in all cases, making the single track section about twenty-five feet in width, and the double track section about thirty-five feet. The contraction joints were located twenty-five feet apart, and were made with asphalt separator strips furnished by the Hydrex Felt and Engineering Company. The shoulders of the road sloped away at the rate of about one inch to the foot, and formed the gutter.

The idea of using crushed trap-rock chips for covering the bituminous dressing on a concrete road is an innovation, the credit for which, as far as the writer has been able to learn, belonging entirely to the engineer on this work, Mr. Edward F. Campbell; for, at least in this section of the country, torpedo gravel has always been used. The trap-rock chips make a much better appearance than the torpedo gravel, seem to keep their place on the road better, and in the writer's opinion, are going to prove much more satisfactory in the long run. After a little traffic, the surface looks about the same as a well-built bituminous macadam pavement with squeegee top dressing, and is exceedingly pleasing to the eye of the autoist. It was at Mr. Campbell's special request that Tarvia A was used as a bituminous binder in this work.

At the south end of the job, where the single track stops, about one hundred feet from the Shore Road, Mr. Campbell provided for reinforcement, and because of the lack of a convenient way around, this had to be placed without stopping traffic at this point. It was necessary to lay the width of about thirty feet in two sections, and it was particularly desired by the engineer and the village authorities not to have an open joint parallel to the traffic, but to have this section as nearly as possible a continuous block across the road, with the usual twenty-five-foot contraction joints running from side to side. This was accomplished in as satisfactory a manner as seemed possible, in the following way:

A form was set on one side of the road in the usual way, and a special form was made along the middle of the road by placing three two-by-six-inch side forms upon one another flat. Then the grade was regulated properly, and the top board of the center form was removed, leaving the center form temporarily four inches high. The concrete mixture was next dumped in place and raked to a depth of about four inches all over, when the wire-mesh reinforcement was laid in and allowed to project about two feet over the center form. Then the top board was returned to its place on top and nailed, the wire being between, when the top two inches of concrete was at once applied and the surface struck. This method worked well, and when it came to doing the other side several days later, the special three-ply forms were removed, the projecting two feet of reinforcement overlapped, and the concrete laid, using the set concrete as the middle form. This provided continuous blocks of concrete twenty-five feet long and extending from side to side of the road, about thirty feet, with what amounts to continuous reinforcement all the way. It remains to be seen whether or not the break in the center will prove a source of weakness. The writer thinks not; that is, not in a sense that will detract from the value of the road.

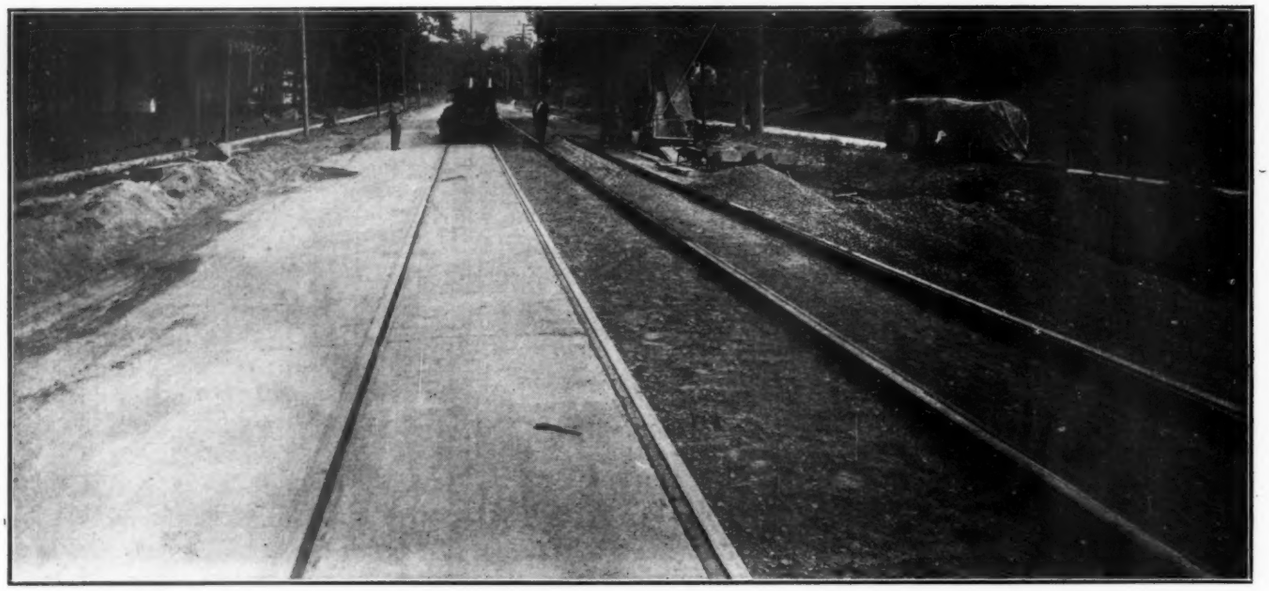



**CROSS-SECTION** *of concrete road construction along street car rail. The incorrect construction on the right side of the rail results in a crack about eighteen inches from the rail. The special construction on the left side of the rail allows for some rail movement, and will probably save the crack in the concrete.*

Laying any pavement abutting a street railway track is always a serious problem, and laying a concrete pavement there is a very serious matter. After a conference between the engineers and the contractor, the railway company agreed to pay for a special construction along the outer side of the outer rails, adjacent to the ten-foot-wide slabs of concrete pavement, but would not go to the extra expense between and within the tracks. The special construction consisted of pargeting the side of the rail from the edge of the head down in a perpendicular line to the point on the base where such a line happened to strike; and care was taken to see that the pargeting, which was a one-three mixture of portland cement and Cow Bay sand, did have a perpendicular side. Against this pargeting was placed a six-inch deep by one-quarter-inch wide asphaltic separator strip furnished by the Hydrex Felt and Engineering Company, the same that was used for the transverse or contraction joints spaced every twenty-five feet along the road.

The asphaltic separator strip was held against the pargeting by means of thin boards and spikes until the wet concrete was in place, when the boards and spikes were drawn and the finishing was done.

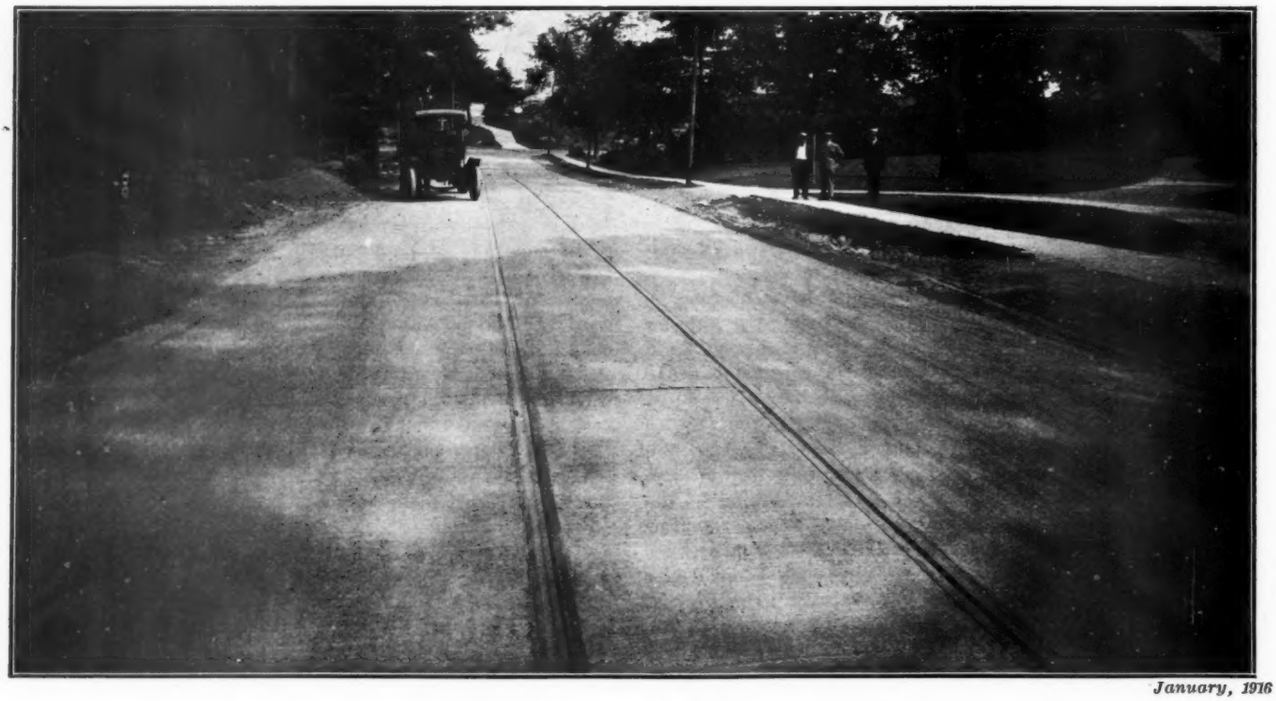
It was the writer's opinion that the use of the asphaltic separator strip between the perpendicular pargeted side of the rail and the mass of the concrete pavement would serve two purposes. In case of a slight settlement of the rail, it would give and prevent the rail from carrying down with it a sec-



PELHAMDALE AVENUE *concrete road. Concrete surface on half the road before bituminous top dressing was applied. Double track street railroad.*

tion of the concrete pavement about eighteen inches wide by causing the concrete to crack about that far from the rail; and the asphaltic separator strip, because of its plastic nature, also somewhat elastic, would act to arrest the vibration of the rail as heavy cars passed over it, thereby saving the concrete from this destructive action. Since the work has been finished, the first contention has been proven. In places where the rails did settle, tho merely a small fraction of an inch, on the side where the special construction was used the pavement showed no signs of damage whatever, while on the inner side of the rail a hair crack appeared about eighteen inches away from the rail, and a slight movement was noticed. This was not only true in one spot, but in several places. The damage was not serious, and now that the bituminous top dressing has been applied, is not noticeable and may never cause any serious trouble on a road of only moderate traffic and on the inside of the rail. It would seem that no other result could be expected from running the concrete under the head or lip of a girder rail so that it sets firmly against the web; certainly, if the rail goes down ever so little, the concrete must go down with it, and something must give. The price for the special construction was five cents a running foot, including pargeting and asphaltic separator strip, but it displaced three cents worth of concrete road, so that the net cost was but two cents per running foot. It seems to the writer that it is

PELHAMDALE AVENUE *concrete road, single track street railroad. Concrete completed, but bituminous top dressing not yet applied.*



easily worth that added expenditure; especially so on the outer side of the rail, where a break would come directly at a point of heavy wheel traffic; and even on the inner side.

Before the top dressing was applied to the road, its full length was carefully inspected and all defects were remedied, tho there were none of real importance found. The road had been open to traffic about ten days after each section was completed, and the contractor's twelve-ton macadam roller had been up and down it several times without effect.

The Pelhamdale avenue concrete road will undoubtedly be watched very carefully by many road engineers in and around New York City. Many have already examined it, and they will be back for further observation from time to time. As it is the closest considerable stretch of concrete road near New York City, and is known to have been laid under very strict inspection, it will probably be a show road for advocates of concrete road construction and bituminous top dressing.

Mr. Edward F. Campbell, the village engineer, spent a good part of each day on the work, and when absent, was competently represented by an engineer inspector in his employ, Mr. John Christal. Mr. E. M. T. Ryder, the engineer of maintenance of way of the Westchester Electric Railway Company and the Third Avenue system, also gave the road some personal attention, and was represented by Mr. John A. Gunn, a regular employe of his office. Mr. J. C. Wilberding, the president of the village of Pelham Manor, took a keen interest in the construction of the road, and with the asistance of Mr. Campbell, followed its every detail.

At the contractor's selection, because of his long personal experience with it, Giant portland cement was used exclusively, and this brand proved by frequent personal tests to more than meet the standard specifications, and entirely satisfied the engineer. Mr. Leahy has a five-year guarantee on the road, and states that he is not afraid of it.

## Electrolysis in Providence, R. I.

Electrolytic conditions in Providence, R. I., have been under investigation for the past year or more. It was reported a year ago by the public service engineers, Robert L. Brunet, that stray currents from the street railway system were causing material damage to water and gas mains and also affecting telephone cables.

In a report issued recently to the Commissioner of Public Works, the engineer details the injuries done, tests having been made for potential differences between the railway company's rails, and the water and gas pipes, between rails and bridges, bridges and river and between water mains and river.

On the whole, conditions have improved over those found a year ago, which would indicate an improvement in rail bonding. The effect of rail drainage depends on the radius from the power station. In Providence, some distances are long, and to reinforce rail drainage additional negative return feeders must constantly be installed, to limit the liability of damage and also to economize power.

Specimen effects of electrolytic action were the corrosion of lead services which necessitated the renewal of service pipes in a large number of cases; the pitting of a main to the depth of ⅛ to ¼ in.; the complete breakdown of service pipes, resulting in flooding; practical destruction of a water meter; and marked deterioration of a water main attached to a bridge.

In the above cases a difference in potential was found: between water pipes and tracks, 1 to 2½ volts; between water and gas pipes, 2½ to 5½ volts; between rails and bridge, 1.1 volts; rails and water main, 1.1 volts and bridge and water pipe, .2 volts.

Tests of gas mains of the Providence Gas Co. showed a difference between gas pipe and rails of 2.9 to 4.2 volts and a flow of 4.1 to 8.3 amperes from mains to railway track. A gas main was found conveying 52 amperes from the river and transferring it to the track system at some distance.

Mr. Brunet reported that of the 946 open and 1,245 defective rail joints of the Rhode Island Co., a large number have been remedied. It was found too expensive to put in effect the engineer's recommendation to weld the joints electrically, but the official holds it to be the railway's duty at least to weld the rail bonds electrically.

Another recommendation is that pilot wires be connected to various points on the track network and run to the basement of City Hall, to be used in connection with smoked chart instruments which would indicate the over-all potential variations between which measurements can be made. The railway company is further asked to renew at once all broken and imperfect rails, and adopt the gradual system of electrically bonding rail joints.

## The Utilities Bureau

Suppose the citizens of Jonesville make up their minds that the rates charged by their gas company ought to be lower. Jonesville has 40,000 inhabitants. Their gas company is capitalized at $700,000. The contest does not look unequal. It would not be unequal if the gas company were really as isolated and self-dependent as Jonesville.

But the gas company is not dependent upon itself alone. It is controlled by a holding company capitalized at $110,000,000. If the holding company cares to, it can put more money and experter experts into this case than Jonesville can afford. The case may raise questions certain to come up again in disputes between other communities and other plants controlled by the holding company. The more important the case, the less likely is Jonesville to present its side as forcibly as money and organization enable the holding company to present the corporate side.

Holding companies control nearly five and half of the eight billions invested in American gas, electric, street railway and interurban railway companies. About 89,000,000 persons are served by electric light and power and gas companies. Holding companies serve sixty-two of these eighty-nine millions, or about 70 per cent. Holding companies control 76 per cent. of the two billions invested in electric light and power; two-thirds of the billion and a third invested in artificial gas; two-thirds of the five billion invested in street and interurban railways.

The functions of this Utilities Bureau are to collect and collate data as to rates, service standards and cost factors in municipal utilities; to prepare these data for use of cities, public bodies, corporations and interested citizens; to help by study and advice cities that want help in solving their utility problems; to codify the decisions of public service commissions and other judicial and quasi-judicial bodies; to make and keep up a list of engineers, lawyers, accountants and valuation experts; to encourage the introduction of cost-keeping methods, similar to those followed in the industries, thruout the utilities, whether publicly or privately owned, and to develop standard forms and methods for reporting basic facts; to serve as a national agency thru which American cities may co-operate by exchanging data as to cost factors, service standards and rates.

The Bureau is organized with Charles R. Van Hise, president of Wisconsin University, as president, and men prominent in municipal betterment movements on its board of trustees and mayors of the large cities as sponsors. Morris Llewellyn Cooke of the Philadelphia department of public service is acting director, with his office at No. 216 Pnladelphia City Hall, and will give any desired information regarding the work of the Bureau.

# THE ACTIVATED SLUDGE METHOD

## OF SEWAGE TRATMENT

*This brief history of the rapid development of the activated sludge method of sewage treatment is abstracted from the results of the research of Prof. Edward Bartow, of the University of Illinois, who is at the head of the water survey of the state. It shows that there is much promise in this latest attempt to solve the great problem of the disposal of the sludge resulting from sewage treatment, in part by destroying some of it in the treatment process, in part by making it innocuous and practically inoffensive, and in part by giving it some value as a fertilizer not too low in grade for practical use.*

Sewage treatment by aeration in the presence of sludge is the latest development in sewage disposal.

Air has always played an important role in sewage disposal. The earliest application of air was the exposure of sewage on the ground or in shallow pools. The disposal of sewage by irrigation is an aeration process. No more sewage can be added to land than can be thoroly oxidized. The disposal of sewage by dilution in streams also depends on the amount of air present. The amount of sewage which can be purified by a stream is limited by the amount of dissolved oxygen present.

Intermittent sand filtration where sewage is added intermittently to sand beds is an aeration process. The action of contact beds is of a similar nature. Sprinkling filters, the most practical process up to the time of the suggestion of activated sludge, depend upon aeration accomplished by spreading the sewage in a finely divided state into the air.

Preparatory treatment of the sewage is necessary, and consists in using screens, grit chambers, settling tanks, digestion tanks or chemical precipitation, according to conditions.

Grit chambers and settling tanks remove suspended matter. The amount of purification is comparable with the amount of purification by screening.

Digestion tanks accomplish the partial destruction of the suspended solids and soluble organic matter by anaerobic bacteria.

The addition of chemicals assists sedimentation and retards digestion, giving an increased amount of sludge, but a much improved effluent. Neither the screening nor the sedimentation nor the digestion nor the chemical precipitation produce complete purification. Aeration processes must complete the purification.

Edward Bartow, of the University of Illinois, in a paper before the Iowa section of the American Water Works Association, discusses the latest process, the aeration of sewage in the presence of sludge, and also gives results of tests of sludge as fertilizer.

Numerous experiments of blowing air into sewage have been made, both in America and in Europe. Until recently none of the experiments were at all promising and the conclusion was that such means of purification was not practical. In this country, the first promising method was that used by Black and Phelps in New York. They blew air thru the sewage as it passed over a series of inclined wooden gratings. This sewage was in contact with the air for varying periods up to twenty-four hours. The experimental tank has been adapted to experiments with activated sludge.

The next experiments are those reported by Clark and Gage and Adams at the Massachusetts State Board of Health experiment station in Lawrence. Air blown thru sewage reduced the organic constituents. The seeding of the sewage with green growths accelerated the action. Their best results were obtained when the tank contained slabs of slate covered with a brown growth of sewage matters. This treatment produced an effluent which could be filtered at several times the normal rate. It, however, simply prepared the sewage for addition to sand beds, and was not considered a final process.

Gilbert J. Fowler, of the University of Manchester, was in this country in November, 1912, in connection with the disposal of the sewage of Greater New York and visited the Massachusetts experiment station. Fowler and Mumford carried on experiments with a specific bacillus, which they named M-7, which was collected from the waste water from a colliery. This bacillus with aeration has the power of separating iron as ferric hydroxide from iron-bearing sewage, carrying down with it the suspended matter, and furnishing a non-putrescible effluent. Fowler sugested to Ardern and Lockett, who were in charge of the Manchester sewage disposal works, that they try experiments in aerating sewage on lines somewhat similar to what he saw in Massachusetts. As a result, the activated sludge process is being developed.

The first description of it was given by Ardern and Lockett, April 3, 1914, at a meeting of the Manchester section of the Society of Chemical Industry. In their first experiments, Ardern and Lockett used bottles having a capacity of five pints, and drew the air thru the sewage by means of an ordinary filter pump. Air was drawn thru the sewage until it was completely nitrified, requiring about five weeks. The supernatant liquid was drawn off and additional sewage added. This method of treatment was repeated a number of times with the retention each time of the deposited solids. As the amount of deposited matter increased, the time required for each succeeding oxidation gradually diminished. Finally, a well-oxidized effluent, equal to that from efficient bacterial filters, was obtained in from six to nine hours.

In their second series of experiments, reported to the Manchester section of the Society of Chemical Industry, November 6, 1914, they used barrels of fifty gallons capacity and added the air thru porous tile. They have tried treatment with a continuous flow of sewage without conclusive results. In later experiments they used tanks of 20,000 gallons capacity. Their results were very satisfactory and led to additional work in England, especially at Salford, where Duckworth and Melling adapted scrubbing filters to the use of the activated sludge process with great success.

Experiments were begun with F. W. Mohlman at the University of Illinois on November 2, 1914, using bottles of three gallons capacity. On January 4, 1915, a tank nine inches square and four and one-half feet deep was put in operation. In the bottom of this tank was placed a porous plate made of material known as "Filtros," furnished by the General Filtration Company, Rochester, N. Y. The plates are made of a very pure and carefully graded quartz, fused together with powdered glass. The results of our first experiments were similar to those of Ardern and Lockett. Sewage placed in the bottles or in the little tank was submitted to a current of air for a sufficient period to oxidize it completely.

It is not necessary to obtain complete nitrification to ob-

tain a clear or stable effluent. More information must be obtained before the amount of nitrification required can be known.

The process is undoubtedly bacteriological. The sludge is very rich in bacteria but the number in the effluent is comparatively small. In our laboratory, Mr. Robbins Russell investigated the bacteriological properties of the sludge. Several species of bacteria were isolated from the sludge, including two kinds of nitrifiers and about fifteen other varieties. Experimenting with sterilized sewage, it was found that the nitrifiers alone would not purify the sewage. Mixtures of the nitrifiers with the other bacteria would completely purify the sterilized sewage.

In an article which was presented before the American Chemical Society, mention was made of some worms which developed in the process and which were identified by Professor Frank Smith, of the zoological department of the University of Illinois, as Aeolosoma Hemprichi. It seemed possible that these worms might play an important role in the purification process. Having isolated about two hundred of these worms as completely as possible from the bacteria and sewage, Mr. Russell added them to sterilized ammonia broth and aerated it, obtaining practically no nitrification. The worms are, therefore, not essential and the bacteria which were isolated from the sludge did nitrify sterilized sewage.

The fresh sludge is odorless. It will putrefy if left with a large amount of water. After filter pressing it is stable. The dried sludge has an odor similar to that of fertilizers.

As in other sewage disposal processes, the ultimate disposal of the sludge is of great importance.

The disposal of the sludge can be most easily accomplished if it has manurial value. That activated sludge has manurial value is shown by its chemical composition, by its reaction with various soils, and by its effect on the growth of plants. Specimens of sludge obtained at the experimental plant have varied in nitrogen content from 3.5 to 6.4 per cent. The lower values were obtained during periods of high water. Street wash was getting into the sanitary sewers and since no grit chamber was provided to remove the grit, the nitrogen value of the sludge was greatly lowered. The tests of the fertilizer value have been made on the richer specimens which were first obtained.

Thru the courtesy of Mr. Paul Rudnick, chief chemist, Armour & Company, Chicago, the availability, according to alkaline permanganate method as used by the New England states was shown to be below 50 per cent. (44.7 per cent.), and the sludge would be classed as an inferior ammoniate, but the availability according to the neutral permanganate method which has been adopted by the southeastern states was shown to be about 85 per cent. (89 per cent.) and would therefore be classed as satisfactory.

While it seems to hold a medium position, it nevertheless resembles very much more closely in its general characteristics, so far as available nitrogen is concerned, the so-called high-grade organic nitrogenous fertilizers, dried blood and high-grade tankage, etc., rather than the low-grade nitrogenous fertilizers, steamed bone meal, cotton seed meal, garbage tankage, etc.

Although the chemical tests and the nitrification tests with soils indicate that the activated sludge has a high fertilizer value, the final test must be its effect on plant growth. Pot cultures, using wheat, were started in March, 1915, under the general direction of Professor C. C. Hopkins and with the assistance of Mr. J. C. Anderson, details of which are given in the paper.

The sludge causes such a rapid growth of wheat, that it should be valuable to truck gardeners, to rush the spring crops. To test its value to the market gardener, three plots, each two feet by three feet, were laid out in a field. One plot was not fertilized, one was fertilized with an equivalent to 126 pounds of nitrogen, one ton of sludge per acre, and the third with an equivalent of extracted sludge. On April 24, 1915, two rows of radishes and lettuce were planted in each of the three plots. The plants in the plot where the extracted sludge was used came up first, a little ahead of those in the plot where the unextracted sludge was used. At the end of two weeks, the lettuce and radishes of the treated plots appeared to be twice the size of those in the untreated plot. At the end of four weeks the plants were thinned. The roots of the radishes from the treated plots were already red and quite rounded near the tops, while those from the untreated plots had not yet started to swell and had not become red. The lettuce plants from the treated plots were nearly twice as large as those from the untreated plots.

The increase in weight, due to the sludge, is 40 per cent. in the lettuce, and of 150 per cent. in the radishes. The radishes from the sludge pots when cut open and eaten were found to be very crisp and solid, and to have a good flavor. They were weighed.

These pot cultures and gardening experiments show that the nitrogen in "activated sludge" is in a very available form and that activated sludge is valuable as a fertilizer.

The process is attracting a great deal of attention in America. The most extensive work is being done at Milwaukee. Two tanks of 1x5x10 feet deep and one tank 10½x32x10 feet deep have been operated on the fill and draw plan and one tank 10½x32x10 feet deep is operated on the continuous plan. The Milwaukee sewerage commission has awarded contracts for the construction of a plant to treat 2,000,000 gallons of sewage per day by continuous flow. At Baltimore, they have been working on a small scale but have adapted two of the new Imhoff tanks for use by this process, and it is expected that in a short time they will be using activated sludge on a large scale. At Washington, the Hygienic Laboratory of the Public Health Service is experimenting on a small scale and is co-operating with the department at Baltimore in their experiments. At Cleveland, experiments are being carried on in the sewage experiment station. They have adapted tanks 5x10 and 5 feet deep, which they used in their sewage experiments, to the process, and while it has barely begun, they are getting promising results. Experiments are to be carried out on a larger scale. At Regina, Saskatchewan, experiments on a considerable scale have been carried out and their results are reported by R. O. Wynne-Roberts. At Houston, Texas, they are planning to use the process in a plant to ultimately treat the sewage from 160,000 people. They do not expect to obtain complete nitrification, as they do not believe that a completely purified effluent is necessary. In Chicago, the Sanitary District of Chicago is using tanks about 2 feet in diameter and 8 or ten feet high with quite satisfactory results, using the waste from the stockyards, one of the most difficult wastes that we have to treat.

At the University of Illinois, four reinforced concrete tanks have been completed and put in operation. These tanks operating on the fill and draw system, are designed for studying in a comparative manner the amount of air required, the best method for distributing the air, the time required for purification, and the quantity and quality of activated sludge formed. The paper contains detailed descriptions of these tanks and methods of operation of them.

The quality of the effluents has usually depended more on the strength of the raw sewage than upon any other variable. The tanks when operating on a six-hour cycle, were filled at 9 a. m., 3 p. m., 9 p. m. and 3 a. m. The strength of the raw sewage, estimated by the free ammonia values, averages for the 9 a. m. sewage between 20 and 35 parts per million, for the 3 a. m. sewage, between 3 and 12 parts per million. Nearly all of the 3 a. m. sewages have given stable effluents, but the

strong morning sewages have quite frequently given putrescible effluents. Unless the sludge is in good condition, and well nitrified, a strong sewage cannot always be purified in four and one-half hours, even by increasing the air to 800 cubic feet per 400 gallons. In the normal working of the plant, the sludge will usually regain its "activity" if 800 cubic feet of air is applied for several periods after the strong sewage has been added. At times, however, with a succession of strong sewages, it is necessary to increase the time of aeration in order to obtain good effluents. When strong sewages are to be treated, a definite cycle of operation cannot be established without provision for longer aeration of the sewage or separate aeration of the sludge. In order to keep the sludge in its most active state, complete nitrification of each sewage is necessary. Effluents are usually stable if 50 per cent. of the free ammonia is removed, and 2 to 3 parts per million of nitrogen as nitrates is present. A completely nitrified effluent is neither necessary nor economical. The greatest efficiency in air consumption will be obtained when enough air is used to make the sewage non-putrescible and to keep the sludge activated. The operation of the plant during six months has suggested the advisability of studying more carefully such other features of the process as the amount of sludge formed, the building up of nitrogen in the sludge, and the composition of the effluent gases.

# THE WATER SUPPLY OF WATERLOO, IOWA

In 1886, Waterloo, Iowa, had a population of 10,000 and installed a water works plant with mechanical filters to purify the water pumped from Cedar river. The supply being inadequate and not always of the best, the development of artesian wells was begun in 1904. The following description of the wells is abstracted from a paper before the Iowa section of the American Water Works Association, by J. P. Berry, the superintendent of the plant.

W. H. Gray & Bros., of Chicago, contracted to drill a 15-inch well to a depth of 200 feet, then 9 inches to a depth of 484 feet, and 8 inches from there to the bottom, a depth of 1,375 feet. A great deal of trouble was experienced, especially in the first 200 feet of 15-inch hole. The first water-bearing artesian sands were found at a depth of 840 feet, and were about 40 feet thick, the water rising to street grade. At a depth of 1,300 feet, a stratum of Potsdam or Jordan sand was found, 75 feet thick and pure white, from which the discharge was 210 gallons per minute, with a head of 19 feet. This well was completed in July, 1905, just one year after drilling was commenced, at a cost of $5,721.79.

This well was equipped with a Byron Jackson deep well pump placed in the well to a depth of 106 feet, and driven by a Filer and Stowell engine delivering 700 gallons per minute. Water stood at a depth of 75 feet below the surface when the pump was in operation. This well was operated continuously for two years, when, on account of caving of the well at the 800-foot level, it was found necessary to shut down for repairs. The well was cleaned out and 350 feet of casing was added, extending up into the 15-inch pipe, with a lead seal placed between the pipes to prevent the entrance of surface water.

In November, 1914, it was found by analysis of water taken from this well that surface water was finding its way into the artesian supply. We decided at this time that we would pull the old casing and replace it with new. The word "casing" is used here only to show its purpose in the well, as standard drive pipe was used in all cases, not the light pipe usually called casing. For making our repairs, we purchased from the Armstrong Mfg. Co., Waterloo, Iowa, one of their largest size drilling machines, large enough to drill any future wells the city may need, and make any repairs that may be necessary on our present wells. In pulling our casing, what is known as a Fox trip spear was used, and the casing was removed without any trouble. The casing was found to be badly rusted, some places entirely rusted away, and in other places as thin as stovepipe. This was steel pipe and I have seen wrought iron pipe that had been in service over twenty years in the same kind of water that was in better condition than our pipe was at seven years. A word to the wise should be sufficient.

New wrought iron standard drive pipe casing was placed in this well, seals were placed between the different sizes of pipe and the well was put in operation. Analyses showed that surface water had been entirely shut out. The repairs on this well were made in about sixty days, and during this time the well drilling machinery was operated by electricity. It worked well and at 2 cents per k.w., electricity cost us about $12.00 for the entire job. It has not been necessary to do any repair work on any of the other wells.

No. 2 well is almost a duplicate of No. 1. It is operated by a 40-h.p. motor belted to a deep-well centrifugal pump, and when first tested the well delivered 700 gallons per minute. This well was drilled in 1907 and has been in service almost every day since that time. First tests of this well showed that when the pump was delivering 700 gallons per minute the water stood 75 feet below the surface, and more recent tests show that the water stands at the 100-foot level, and that the discharge of the pump is a little over 600 gallons per minute. This is due to the lowering of the head and perhaps some to the condition of the pump. The cost of this well was $8,053.51.

Well No. 3 was drilled in 1911. Its depth is about the same as the other wells, but its size is much larger, being cased 20 inches to a depth of 200 feet. From this point to a depth of 860 feet it is cased with 12-inch pipe, and from this point to the bottom, 1,377 feet, it is drilled 12 inches. This well was equipped with an 18-inch centrifugal pump, direct connected to a 75-h.p. electric variable-speed motor, that is, the pump may be run at either 850 r.p.m. or 1,150 r.p.m by changing the switch.

In this well the water from the St. Peter or first water bearing sands, is cased off, and for this reason, we have not derived much benefit from the high speed of our pump, as at 1,150 r.p.m. the pump does not fill. At 850 r.p.m. the pump delivered 800 gallons per minute. The cost of this well was $10,854.56.

Well No. 4 was drilled in 1914 and is 1,378 feet deep. The first 200 feet is cased with 15-inch wrought iron casing, the next 675 feet is cased with 9-inch casing. The 9-inch goes to the bottom of the St. Peter sand and where it passes thru the St. Peter sand it is perforated to admit the water from these strata. This well is equipped with an American deep-well pump and a 60-h.p. direct connected motor. This motor is using about 56 k.w. per hour and the pump is delivering about 800 gallons of water per minute. This well seems to be our best well, everything considered. It was drilled by the J. P. Miller Artesian Well Company. The time required to drill this well was about five months, while all of our other wells required a year. The cost of this well was $8,356.00.

Our four artesian wells are located in a space of about 4,000 feet, the first three in 2,000 feet, and the fourth 2,000 feet away. We find that there is some interference between the different wells.

# Ornamental Street Lighting Units

**By Gilbert T. Dunklin, South Bend, Ind.**

*This brief article gives an idea of some of the later designs for ornamental street lighting units, departing from the earlier heavy cluster designs, which had a very heavy effect by daylight not entirely compensated for by their usefulness at night. With the higher candle power lamps now available the single lamps give as good service as the clusters did and are much handsomer, both by day and by night.*

THE introduction of Mazda "C" (gas-filled) lamps has revolutionized methods of ornamental street lighting. The pretty, but wasteful, cluster posts have given way to the more efficient and dignified single light posts. In place of clusters of small multiple lamps, posts now support single light units of high candle power. The method of current distribution has changed from 110 to 220-volt multiple circuits using either two or three conductor cable, to high potential series circuits using single conductor cable. These changes are due largely to the distinctive qualities of the new lamps; the most important of these influence the design and selection of modern street lighting units and may be stated briefly as follows:

1. Mazda "C" lamps are made in large sizes permitting wide spacing of lighting units. This reduces the initial cost of installation to a minimum.

2. The new lamps are more efficient in the large sizes than in the small sizes, consequently the maintenance cost is less for single units of high candle power than for clusters of small lamps affording the same amount of illumination.

3. The large series lamps, especially those made for 15 and 20 amperes, are the most efficient incandescent lamps for commercial purposes on the market today. Not only is the initial cost of installation greatly reduced by the use of single conductor cable for high potential series systems, but the amount of current consumed by the 15 and 20-ampere series lamps is about 25 per cent. less than for multiple lamps of approximately equal candle power rating.

4. Series lamps are more rugged in construction than multiple lamps. Their life is longer and consequently the expense of lamp renewals is less for series systems than for multiple.

The peculiar operating characteristics of the new lamps have a most important bearing on the design of the lighting unit. The conditions to be fulfilled are as follows:

1. Sufficient ventilation to prevent excessive heating of the lamps.

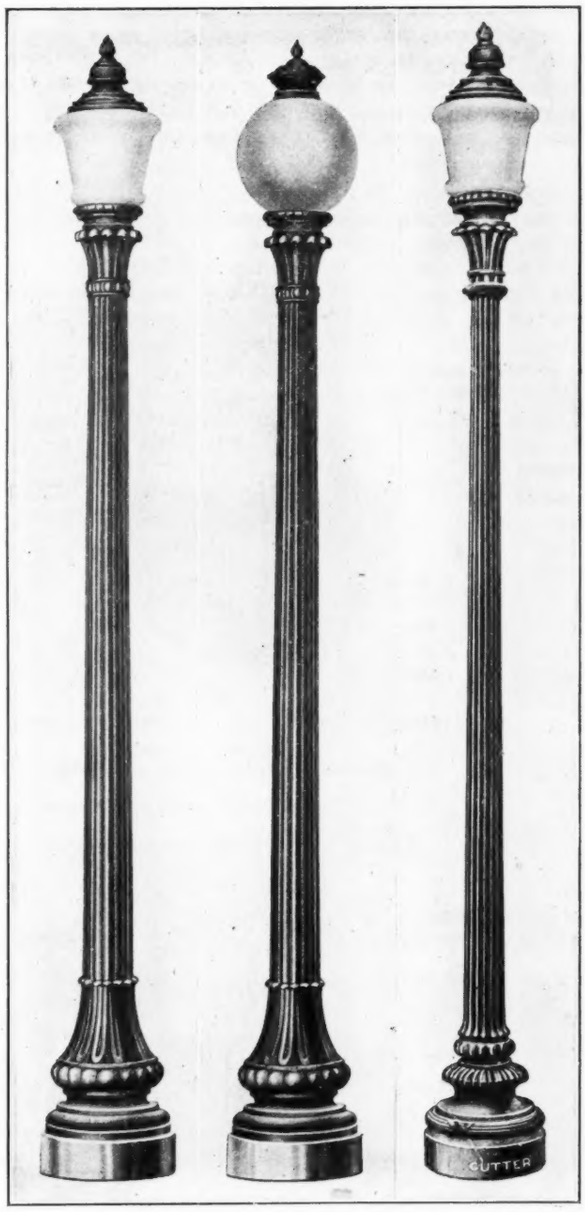
2. Elimination of glare due to the high intrinsic brilliancy of the concentrated lamp filament.

Ventilation is provided by means of a globe with two openings. Two styles are illustrated in Figures 1 and 2. A ventilator covers the top opening of each globe, thus protecting the lamps from moisture. Insect screens are provided in both globe holder and ventilator so that frequent cleaning is not necessary.

Glare is eliminated by mounting the units at the proper height above the sidewalk and concealing the lamps in globes of diffusing glass. The final results depend upon the shape and compositon of the glass used.

*Cadillac (Mich.) Installs Efficient Lighting Units.*

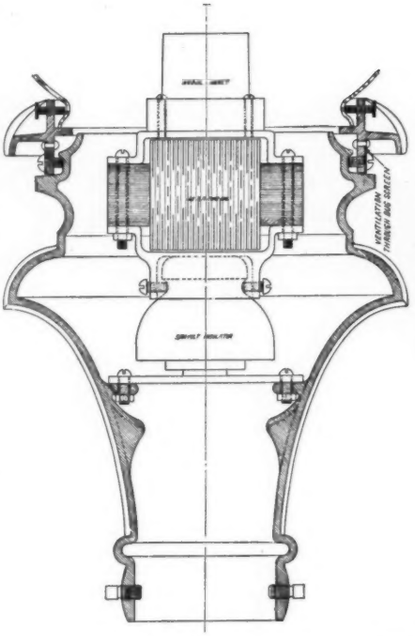
In May, 1915, post tops of various shapes and styles were submitted for trial and test at Cadillac, Michigan. Luminometer readings were taken on the street surfaces. The unit illustrated in Fig. 1 was selected as the most efficient and artistic. The filament of the lamp could not be seen and the absorption of light was less than for any other glass available. Characteristic light distribution with this type of globe is illustrated in the upper polar diagram, Fig. 4. Here it is compared with the ventilated ball-shaped globe which allows more



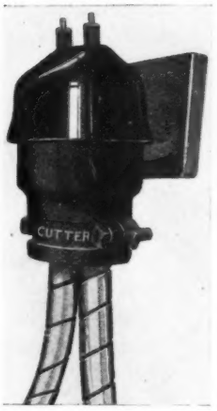

LEFT. *Continental post with Sol-lux, Senior, ornamental top.* CENTER. *.Continental post with sixteen-inch ball globe and ventilator.* RIGHT. *Parkview post with Sol-lux, Junior, ornamental top.*

light to be directed above the horizontal than is necessary for the adequate illumination of building facades. The amount of useful light for the illumination of street surfaces and sidewalks is represented by the shaded portions of the two diagrams. In the diagrams, broken lines indicate candle power values of the bare lamps, while full lines show corresponding candle power values of the same lamp enclosed in diffusing globes. By the use of an internal reflector, attached to the ventilator directly above the globe, a greater density of light is obtained from the "Sol-lux" unit between the angles of 45 degrees and 70 degrees than from the bare lamp. In these directions, the greatest amount of light is needed for ornamental street lighting purposes.

One especial advantage of using the new high candle-power units is that objects on the street are seen more easily by contrast than on streets lighted by clusters of small lamps. Clusters afford more diffusion than single light units, but it has been demonstrated that surface irregularities and moving objects are discerned by contrast more easily if the light comes from one direction than by light coming from a number of directions. With the new single-light unit installed at Cadillac, the greatest amount of light comes from that direction most

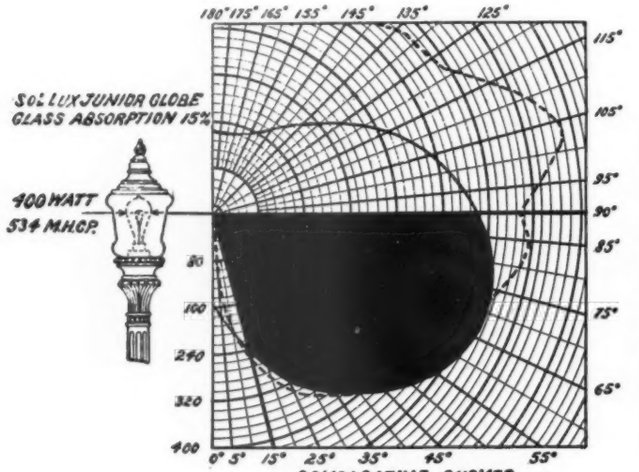


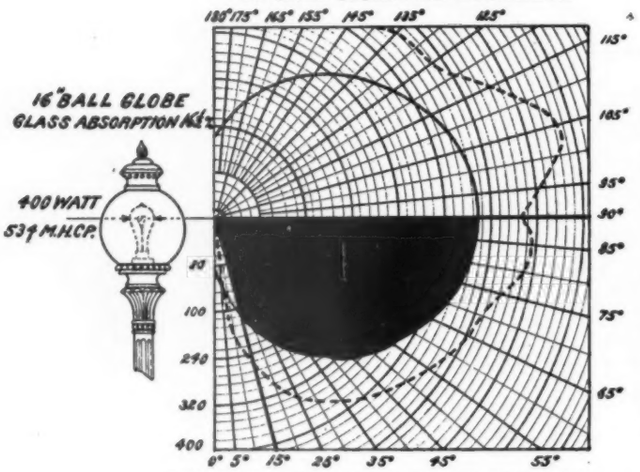
SECTIONAL VIEW *of ornamental post top, showing method of insulating compensator coil and socket from post.*




POT HEAD.

POLAR DIAGRAMS *showing light distribution and absorption.*





16" BALL GLOBE
GLASS ABSORPTION 4%
400 WATT
534 M.H.C.P.
SHADED PORTION SHOWS USEFUL LIGHT FOR STREET ILLUMINATION. UNSHADED PORTION SHOWS LIGHT AVAILABLE FOR LIGHTING BUILDING FRONTS.

useful for street lighting purposes. This unit is therefore superior to both the cluster top and the ball globe. Its design is attractive and particularly applicable to modern street lighting systems.

The solution of such problems as the prevention of grounds and static discharges is of utmost importance in the design of series underground circuits. In Cadillac, a pothead was installed in the base of each post. It consists of an iron frame with receptacle for insulating compound and with clamps for holding the cable. A porcelain cover has two holes for the wires which lead to the socket in the top of post and a third hole for sealing the connections. The iron frame which forms a part of the cable clamp is fastened directly to the base of the post. This affords a complete circuit for static current and makes a permanent connection from the post thru the cable coverings to ground.

The socket and lamp are separated from the iron post by means of a high tension porcelain insulator, as shown in Fig. 5.

By means of these protective devices, all danger to pedestrians and linemen are eliminated.

Other cities have adopted the same unit. A few of these are: Fort Dodge, Iowa; Prairie du Chien, Wisconsin; Neilsville, Wisconsin; West Liberty, Iowa; Huntington, Indiana.

At West Liberty, Iowa, the standard shown complete in Fig. 1 is used in the mercantile section of the city. In the residence districts, a smaller post and top, illustrated in Fig. 3, are used. In this way, the same decorative scheme is carried out thruout the city. The ornamental top is made in two sizes, one harmonizing with the heavy standard which is appropriate for "White Way" lighting, the other for a small standard, designed especially for the lighting of parks and streets in the residence districts. The two globes are made of the same glass and the light distribution is approximately equal for both. Huntington, Indiana, has adopted this scheme of a systematic and efficient system for the entire city. Approximately 400 posts will be installed by January 1. This installation will be a striking example of what may be accomplished by a city of this size by the use of single-light posts and it will conform to the latest ideas of efficient and artistic street lighting.

# Bituminous Resurfacing of Old Roads

By J. C. Travilla, C. E., Fort Worth, Texas.

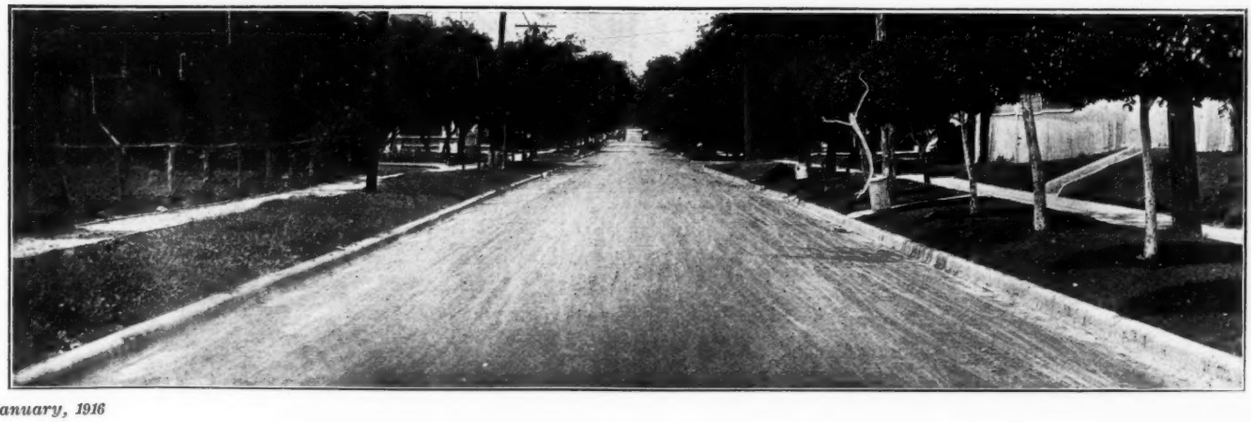
*Mr. J. C. Travilla, of Fort Worth, Tex., and St. Louis, Mo., has been constructing roads in Texas, particularly in Tarrant county, and has developed some special methods, the principles of which are stated in this article, part of which is from a paper before the International Road Congress, and part from a brief report of the work done in Tarrant county. His conclusions are clearly stated and are worthy of careful study, as they may be applied with advantage under similar circumstances anywhere.*

In the resurfacing of old roads to carry the modern traffic, vitrified brick, portland cement concrete, asphaltic concrete, asphaltic macadam, heavy and light asphaltic oils and refined tars, with covering materials, and oils and tars as dust preventives have merit and value. The opinion of the material man and the taxpayer inexperienced in road work should not, however, govern in the selection of materials. The oils, tars and asphalts, on account of their low first cost and availability, are more generally used for the top finish.

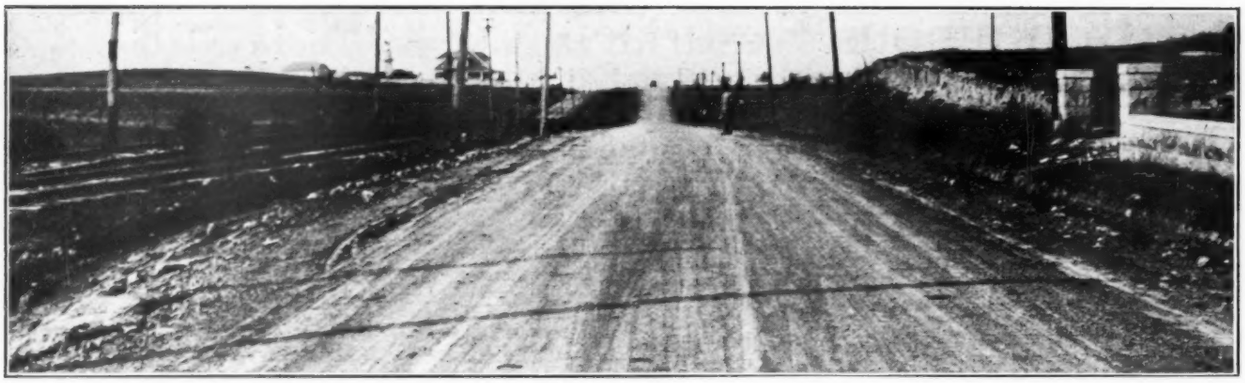
In the treatment with light oils and refined tars the roadbed should first be properly shaped. The surface should be free from dust and the oil or tar applied at the rate of one-sixth of a gallon to the square yard, making several applications and allowing each one to set thoroly. This treatment is recommended where the mileage is large and the funds are limited and where there is much pleasure auto traffic. No permanent results are obtained, but the mineral dust is held on the road, which reduces the wear from abrasion and eliminates the dust nuisance. This method of surface treatment is popular on account of the low first cost. The oil or tar is applied cold and in such a small quantity to the square yard that no covering material is required. It is not objectionable to the traveling public. Some oils act as lubricants to the road metal, prevent the mixing of stone dust with the water when making repairs, which is an objectionable feature in maintenance work. The oil should be semi-asphaltic base product with a gravity of about 20 degrees Beaume, and the refined tar a specific gravity of about 1.07. Better results will be obtained with the oil where the road surface is a sand or flinty gravel. Where the mineral matter is limestone, refined tar will produce better results than are obtained with sand or gravel. A better and more lasting surface may be obtained when the heavier oils and tars are used. However, a covering of sharp sand, gravel or stone chips is necessary to prevent the picking up of the bitumen. In the use of the heavy oils and tars it is necessary to have a compact road surface and not to apply an excess of oil or tar.

Asphaltic cement, heavy oils and refined tars are generally preferable to the lighter products in the resurfacing of old roads. To obtain satisfactory results from their use, experience and attention to details are necessary. A road surface that carries an excess of stone screenings or dust cemented in thin layers will be a failure as the bituminous mat or carpet will break up or peel off. The road surface should be compact and free from an excess of dust. In using asphaltic oils the larger stone in the roadbed should be exposed and the surface slightly pitted so as to obtain a mechanical bond. This pitting is best accomplished by sweeping the road surface. It is desirable to sprinkle the road with water in advance of the application of heavy asphaltic oils, as the water moistens the dust on the stone that is not removed by sweeping and assists in producing a bond between the old and new surfaces. In the use of refined tars a dry surface is necessary. The spreading of the stone chips immediately following the application of oil or tar is an important detail. It will prevent an excess of oil or tar on the edges and quarters of the road and if not given sufficient attention the surface will show "fatty" spots and be corrugated. Stone chips passing the ½-inch mesh and free from dust give the best results. An excess of stone dust will destroy the life of the oil or tar. The oil used should have a gravity from 10 degrees to 16 degrees B., and the refined tar a gravity 1.06 to 1.20, depending on material used and the method of construction.

An improvement in the resurfacing of old roads over a single application of bitumen is to apply two treatments, using a light product as a priming coat and a heavier product as a binder. The light material acts as a penetrant which ties or bonds the bituminous mat to the old road surface. Refined tars do not always run uniformly. They are more readily af-



WEST LAUREL STREET, *Fort Worth, Tex., an asphalt macadam street constructed by the penetration method under Travilla's Class AA specifications.*



WEATHERFORD PIKE, *a main county road of asphalt macadam, eighteen feet wide, constructed by the penetration method under Travilla's Class A specifications.*

fected by atmospheric conditions than the asphaltic cements and heavy oils. Examination of road work where refined tars have been used as the binder shows the lighter oils to have volatilized and the road metal to be badly raveled. On the other hand, tar concrete used for foundation in street paving is in good condition after having been down more than thirty years.

From experiments of others and his own experiences, Mr. Travilla recommends for surface treatment two applications. First, a light coat of refined tar, followed by an application of asphaltic cement. Before applying the asphaltic cement allow the tar to set for twenty-four to forty-eight hours. The stone for two-application work should be graded from that passing 1-inch mesh down to dust. This method of resurfacing will prove satisfactory on roads and residential streets where there is not too much steel-tired traffic. The cost for a 1-inch topping will approximate 25 to 30 cents per square yard.

Where the traffic conditions justify resurfacing with material to a depth of two to four inches, asphalt macadam penetration methods are recommended. Mr. Travilla has built successfully many miles of this class of construction in Tarrant county, Texas, and considers it an important factor in road work. For the base of this construction, the old roadbed is used. Gravel or a soft limestone for a depth of four to six inches after compression may be used. For the wearing surface two to four inches of hard limestone or trap rock are used, depending upon cost, traffic and available material. The stone is graded and applied to obtain the maximum density and mechanical bond of the larger stone which is to carry the load. Refined tar is applied as a paint coat for adhesion and asphaltic cement for cohesion, binder and resiliency, using approximately two gallons to the square yard. The best results cannot be obtained by hand pouring and the use of a pressure distributer is recommended for this class of work.

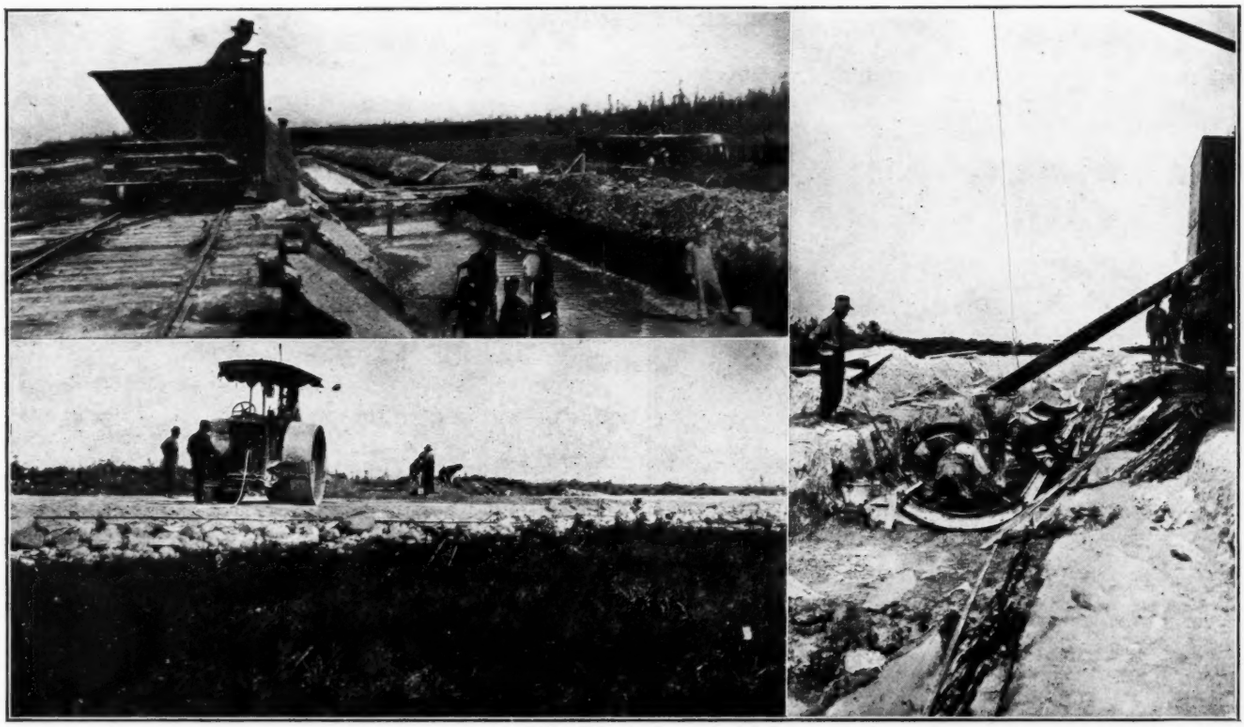
The success of the construction does not depend so much upon the per cent. of bitumen used as it does upon the uniformity in distribution, the mechanical bond of the stone and the density of the mineral aggregate. The best practice is to screen the stone into four sizes from that passing the 2½-inch mesh down to dust and apply the different sizes so as to obtain a minimum voidage. To obtain satisfactory results by this method requires the strictest attention to details. It is not unusual to hear of this method of construction being condemned and of its many failures. The poor success in numerous jobs can be attributed to nothing but inexperience on the part of the engineer.

Asphaltic concrete construction, on account of the material entering into it being carefully determined in advance, has proven a satisfactory method of construction, and specifications can be prepared and followed better with this method of construction than with those heretofore spoken of but, owing to the greatly increased cost, such construction should be restricted to business streets and heavily traveled residential streets.

Many failures are attributed to the use of bitumen in highway construction, but as such a small per cent. is used in making up a roadway surface, undoubtedly most of the failures investigated are caused by the lack of experience and attention to the details with the mineral aggregate which composes 90 per cent. of the wearing surface.

Mr. Travilla spent in Tarrant county, Texas, in 1913 to 1915, about $900,000 on highway surfaces, including about 100 miles of broken stone roads and 35 miles of gravel. The broken stone roads are of two classes, asphalt macadam and water-bound macadam, using hard limestone and the methods of construction above described. The choice of the class and width of road for any line was based on a traffic census, showing number, kind and weight. The macadam roads have gravel shoulders, so that no such road has a usable width of less than 16 feet.

DELIVERING ROAD CONSTRUCTION MATERIAL BY MOTOR TRUCKS.



ABOVE—FILLING WITH SAND AND GRAVEL THE CONDUIT TRENCH, WHICH HAS BEEN EXCAVATED THRU THE SOFT MARSH TO SOLID GROUND BELOW AND MUST BE REFILLED WITH SOLID MATERIAL TO THE GRADE LINE. BELOW—COMPACTING A FOUNDATION FOR THE CONDUIT, WHICH IS SLIGHTLY ABOVE THE NATURAL GROUND LEVEL. RIGHT—PLACING FORMS FOR INVERT OF CIRCULAR REINFORCED CONCRETE SECTION OF CONDUIT NEAR BROKENHEAD RIVER CROSSING, WHERE IT MAY BE UNDER A HEAD OF TEN FEET.

# CONDUIT CONSTRUCTION

## FOR THE GREATER WINNIPEG WATER DISTRICT

*Winnipeg, Manitoba, is bringing its new water supply from one of the lakes connecting with the Lake of the Woods, because the water of this small lake is more satisfactory for a city supply and is a little nearer the city than the main lake. The aqueduct, composed of concrete conduit and iron and steel pipe lines, is nearly a hundred miles long. The general features of the plans for the new works are given as an introduction, followed by a description of some of the practical details of the work of constructing the concrete conduit, more particularly the reinforced concrete portions. The methods of handling materials are of particular interest.*

OWING to the rapidly increasing growth of Winnipeg in the last few years the well system now in operation has for some time been considered inadequate for the future demands of the city, not only on account of increasing demand, but also because of the extreme hardness of the water.

In 1913 the Greater Winnipeg Water District was incorporated comprising the city of Winnipeg, the city of St. Boniface and all or portions of five other municipalities surrounding the city of Winnipeg. The object of the corporation is the supplying of water from any permanent source whether within or without the province for the use of the inhabitants of said district for all purposes.

A board of consulting engineers was appointed to make investigation as to the most suitable means of securing a permanent source of supply, and after exhaustive study of the problem, Shoal Lake, a branch of Lake of the Woods, was chosen as being the most feasible. A practically inexhaustible supply of water can be obtained by a gravity line about one hundred miles in length from this source. The estimate of cost of this work was approximately $13,500,000 for a supply of 85,000,000 imperial gallons daily, which appropriation was authorized by the board and by a vote of citizens of Winnipeg.

The administration of the district is handled by a permanent board consisting of the mayor of the city of Winnipeg as chairman and the mayors and reeves of the various other municipalities of the district. S. H. Reynolds (chairman) and J. H. Ashdown are commissioners whose duties are the managing of the undertaking. W. G. Chace is chief engineer and James H. Fuertes of New York is consulting engineer for the project.

The main engineering features of the system, which is some 97 miles in length, comprise a construction railway with 102 miles of track, including nine sidings, spurs to gravel pits, yards and so forth; a dyke in Indian Bay and a channel for the diversion of the brown waters of Falcon River into Snowshoe Bay; a concrete cut-and-cover gravity aqueduct with appurtenant works 85 miles in length from the intake at Indian Bay to a site chosen for a future 250,000,000-gallon reservoir, southeast of Transcona; 9.8 miles of 60-inch steel pipe between this reservoir and the Red River, a tunnel under the

PLACING OUTSIDE FORMS *in foreground with traveling derrick. The concrete mixing plant is seen on the track, ready to deposit concrete thru chute into the outside forms when all in place.*

Red River, 2.3 miles of 48-inch cast-iron pipe between the Red River and McPhillips street reservoir (the city reservoir now in use). The difference in elevation between Shoal Lake and Winnipeg is approximately 300 feet; the location chosen for the aqueduct distributes this head in a remarkably uniform manner along its entire length.

In the fall of 1913 active work was begun and survey parties were put into the field to find the most economical line. At the same time the designing of the aqueduct was in progress to discover the types of construction most suitable and grades proper for the conditions of the country thru which the line passes, which country contains numerous large muskegs. The work progressed favorably and in the spring of 1914 the final location was established and the contract was let for clearing the right of way, which varies from 300 to 500 feet in width. A large part of this right of way was obtained by grants from the Dominion government.

The year 1914 was spent in building a standard-gage railroad along the south margin of the right of way between Shoal Lake and Winnipeg and also in building the dyke across Indian Bay. This dyke is approximately 7,000 feet long and contains about 230,000 yards of material. A large number of drainage and offtake ditches were necessary in order to drain the right of way properly before actual construction of the aqueduct was commenced. Railway water tanks, miscellaneous railway buildings and engineers' quarters were built. Contracts for the aqueduct proper were let during 1914.

In the spring of 1915 the aqueduct construction commenced and this will be pushed forward with all possible speed until final completion, which is expected in the fall of 1918. For the work contracts were let in five sections to local contractors and at satisfactory unit prices.

The sand and gravel for the concrete is furnished by the district from its own gravel pits. All of the material is first passed thru a screening plant and assorted as to the various sizes and then remixed into suitable proportions so as to make the strongest and most watertight concrete available.

When this work is completed the Greater Winnipeg Water District will have a water supply system of permanent character, which will supply a very high quality of water in abundance for years to come, or until the population reaches about 1,000,000. When these requirements are exceeded, the quantity as supplied by gravity may be greatly increased by pumping, prior to the installation of a second aqueduct.

The conduit of the Greater Winnipeg Water District is some 95 miles long, and nearly 85 miles of it is of concrete, much of it of the horseshoe section shown in one of the accompanying photographs, being all that part in which the conduit follows the hydraulic grade line.

At the lower end, some five miles of the conduit is of reinforced concrete circular section, as it may be under an internal pressure due to some 20 feet depth of water in the reservoir into which it is to discharge. At the crossing of Brokenhead river there is about 2½ miles of circular reinforced concrete conduit which may be under a head of about 10 feet, as the conduit drops about that distance below the hydraulic line. The size of the conduit varies from 5.1 feet diameter circular to 9 feet by 10 feet horse-shoe section according to the slope of the hydraulic grade line and the conduit at various points. The grade line is not a straight line but follows the slope of the ground surface, always running down, with the exception of the river crossing mentioned.

The accompanying photographs show the nature of work done in 1915. Much of the area thru which the aqueduct travels is the so-called muskeg, 8 or 10 feet deep, full of water and practically impassable except when frozen. The conduit is ordinarily laid in a trench 3 or 4 feet deep, so that its crown projects several feet above the surface and it is covered with earth to a depth of 4 feet above the crown, thus making an embankment up to 8 feet high or so and 8 feet wide on top.

HANDLING FORMS BY TRAVELER, *as done on three contracts. The concrete, mixed in a centrale plant, is delivered from cars by the railroad on the side of the trench, thru chutes into the forms.*

COMPLETED SECTION *of plain concrete conduit, horseshoe form of section, where there is no internal water pressure. Note wooden strip water stop imbedded in the surface of the invert side of the joint between invert and arch; also the copper strip around the arch to prevent leakage thru the expansion joint provided at this point.*

The first of the photographs shows the trench thru the muskeg, which is draining itself. When necessary to remove soft material, the trench is dug below the flow line of the aqueduct and then filled up to that level with sand and gravel dumped into the water and the water is then drained out. This process thoroly settles the filling and makes a solid foundation for the conduit.

In the second photograph is shown a foundation at or slightly above the ground surface, made of clayey gravel compacted with a 14-ton roller in 4-inch layers. The large stones seen have been rejected and thrown out by hand. The pipe line seen along the row of stones is used for moistening the gravel and supplying the boiler.

The third photograph shows the laying of the invert of the reinforced concrete circular section under 10 feet pressure near the Brokenhead river crossing. The completed invert with projecting reinforcement ready for the arch forms is seen in the left foreground. Men are placing Blaw forms for invert construction farther back and the reinforcing bars, car containing concrete mixer, concrete chute and hopper are seen in place ready for work on the right of the trench.

The fourth photograph shows this circular reinforced section in various stages of progress. In the background at the right is the railroad built in 1914 by the district to deliver material to the work. It is standard gage and, including sidings, is 102 miles long. The telegraph poles, whistle post and portable cement storage shed show its position relative to the aqueduct.

The gravel and cement delivered by the railroad are picked up by a traveling derrick with a 65-foot boom and discharged into the concrete mixing plant on the car seen in the middle ground. This derrick is just out of sight on the right and is placing outside forms in the foreground, only the fall and a section of the form showing, with the men guiding it to place.

The concrete mixing plant is equipped with a water tank and a ⅝-yard Milwaukee chain-belt mixer and a spout with derrick to handle it and deliver concrete to the forms as shown. On the bank at the left is a pump, used to keep the trench dry.

The fifth photograph shows a method of handling forms and concrete in use on three contracts. In each of these cases a central mixing plant was established with platforms for receiving aggregates, cement shed and concrete mixer, located close to the district railroad track. A narrow-gage industrial railway was located on the spoil bank of the trench excavation, as seen on the left in the picture. On one contract a 3-ton gasoline locomotive hauled the concrete cars from the mixer to chutes opposite the forms to be filled. Outside forms were handled by the traveler, seen over the conduit on the right, which ran on the rails also shown in the photograph. The inside forms were handled on all contracts by special carriage running on tracks laid on the invert.

The sixth photograph shows the cross section of the completed conduit of horse-shoe form. The track for handling inside forms is seen on the invert. The ridge on the surface of the joint to be made between invert and arch, seen on the left, is a wooden stop-water, consisting of a strip of well-seasoned ¾ by 1⅛-inch white pine dressed on both sides. It forms a seal to prevent percolation along the horizontal joints where arch and invert meet. The end of the section of conduit shown is prepared for use as an expansion joint. It shows a copper strip used as a water-stop, consisting of a sheet of 20-gage copper 6 inches wide, extending the full length of the joint. It is bent along the center line to form a ½-inch offset exactly at the joint between the adjacent concrete faces. Chief Engineer W. G. Chace is standing in the foreground.

The seventh photograph shows the complete aqueduct in the foreground and a drag-line scraper in the rear back-filling over it. The machine proved very efficient for this work as well as for excavating the soft material which overlay the firm material on which the aqueduct was laid. On one contract teams and a walking dredge were used for excavation. On another, ⅝-yard revolving Thew shovels were used.

Chief Engineer W. G. Chace has been very courteous in supplying information and the photographs illustrating this article.

MAKING THE EMBANKMENT *which covers the conduit at least four feet deep. The drag-line excavator used on some of the contracts was very successful in this sort of work.*

# COMPARATIVE RAINFALL RECORDS USED IN DESIGNING SEWERS AND DRAINS

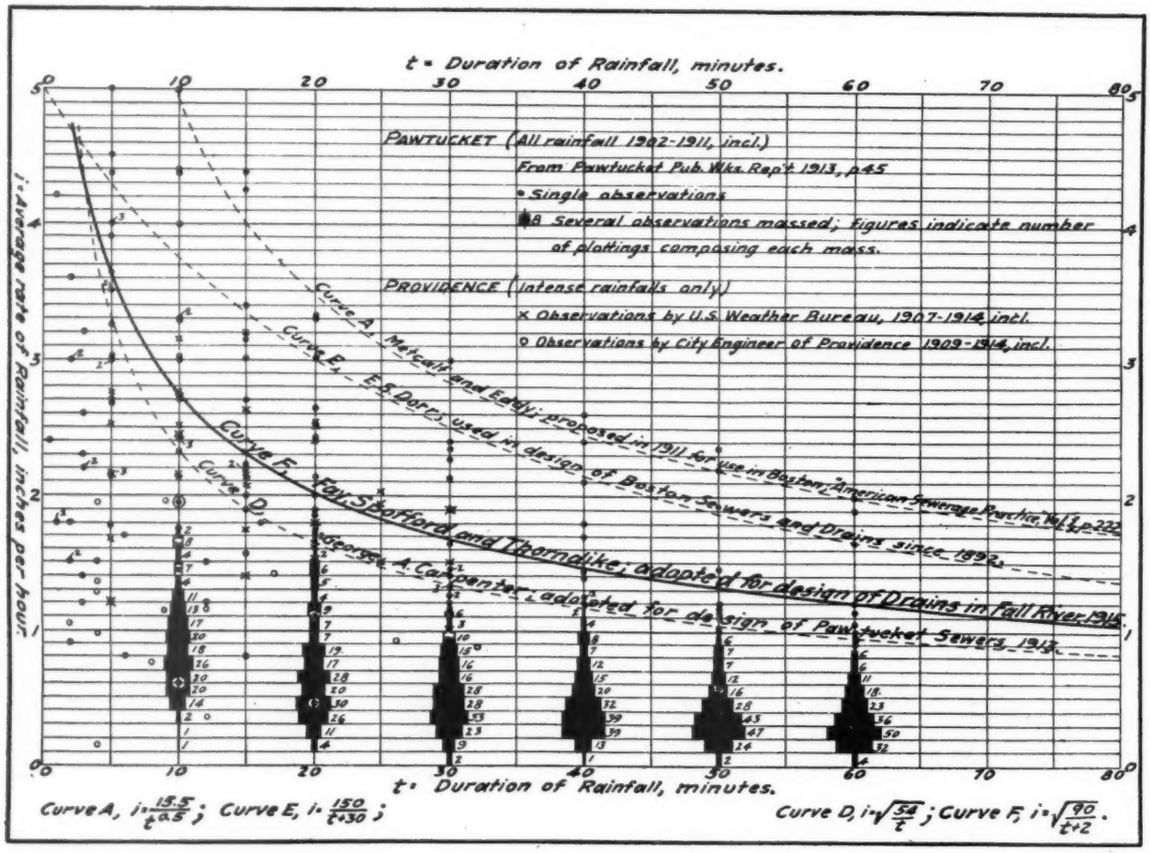
IN connection with the exhaustive study made by Fay, Spofford & Thorndike, consulting engineers of Boston, for the Watuppa Ponds and Quequechan River Commission of Fall River, Mass., an investigation was made of the rainfall.

In designing the surface-water drains, it was necessary to estimate the maximum rate of precipitation lasting long enough to produce the greatest rate of run-off. For the determination of these rates, the records of the ordinary type of rain gage are of no value, for these tell only the amount falling per day, or the total amount which falls in a given storm. Intensity of precipitation can be obtained only from the continuous records of automatic rain gages which record the duration as well as the amount of precipitation. Such gages are comparatively few in number and, there being none in Fall River, it was necessary for the determination of the intensity of rainfall to make use of records obtained from other nearby places similarly situated. A few such records were obtained from the city of Providence, both from the United States Weather Bureau there and from the city engineer's office. From Pawtucket, R. I., a large number of records of a high degree of accuracy were obtained from George A. Carpenter, city engineer. The data thus obtained have been recorded upon the accompanying diagram, and with reference to these data, four curves have been plotted, showing the intensity of rainfall lasting thruout any given interval for which provision may reasonably be made. Curve A shows the maximum intensity of rainfall for any given period of time, which Metcalf and Eddy, consulting engineers, recommended in 1911 to govern the design of sewers for the city of Boston ("American Sewerage Practice," Vol. I, p. 222). This curve lies above the intensity of practically every rainfall of which there is record in Boston.

The intensity of curve E was prepared by Edgar S. Dorr, C. E., formerly engineer in charge of the sewer system of the city of Boston, and has been used in the design of Boston sewers and drains since 1892.

Curve D is that prepared by Mr. Carpenter, and used in the design of the Pawtucket sewers.

Curve F is the one adopted by the consulting engineers as the basis of the design of the surface-water drains for Fall River. Curve F may be represented by the equation: The intensity of precipitation in inches per hour is equal to the square root of the quotient obtained by dividing 90 by the sum of the constant 2 and the time in minutes during which the rainfall of this intensity lasts in the case of any given storm for which it is proposed to make provision in the storm drains of Fall River. It does not give the maximum rates of rainfall which may be expected ever to occur, or which are known to have occurred in the past, because drains designed for such rare and extreme conditions would be enormously expensive, and the excessive cost would not be justified in a city like Fall River. On the rare occasions when rain falls to a greater intensity than the drains can accommodate, a small amount of surplus water will run off over the surface of the ground, just as nearly all of it does at present, or it will stand in the gutters until the rainfall decreases, when the drains can dispose of it. The larger the city and the more closely it is built up, the greater should be the provision made in the drains for the disposal of surface water. For this reason, the two curves for use in the city of Boston lie above those shown for Fall River and Pawtucket.


t = Duration of Rainfall, minutes.
i = Average rate of Rainfall, inches per hour.
PAWTUCKET (All rainfall 1902-1911, incl.)
From Pawtucket Pub. Wks. Rep't 1913, p.45
• Single observations
8 Several observations massed; figures indicate number of plottings composing each mass.
PROVIDENCE (Intense rainfalls only)
× Observations by U.S. Weather Bureau, 1907-1914, incl.
o Observations by City Engineer of Providence 1909-1914, incl.
Curve A, Metcalf and Eddy; proposed in 1911 for use in Boston; "American Sewerage Practice," Vol. I, p. 222
Curve E, E.S. Dorr; used in design of Boston Sewers and Drains since 1892.
Curve F, Fay, Spofford and Thorndike; adopted for design of Drains in Fall River, 1915.
Curve D, George A. Carpenter; adopted for design of Pawtucket Sewers, 1913.
Curve A, $i=\frac{15.5}{t^{0.5}}$; Curve E, $i=\frac{150}{t+30}$;
Curve D, $i=\sqrt{\frac{54}{t}}$; Curve F, $i=\sqrt{\frac{90}{t+2}}$.

# QUESTION DEPARTMENT

## Danger of Pollution of Water Supply from Population on Reservoir Shores

The enclosed copy of correspondence between the Civic Association of Fort Worth and the United States Public Health Service is self-explanatory. The principal question involved is whether rapid filtration of a water supply thru sand, preceded by coagulation, may be relied upon to remove any pollution caused by using the immediate vicinity of the reservoir as a public park.

This bureau has been asked to prepare a municipal exhibit to be shown in Austin and Fort Worth next February, and interested people have requested us to emphasize, by means of charts, the danger to public health that would result from such action as the city has contemplated. Can you, from your experience and wide information on current improvement problems, put us in touch with any actual cases of such pollution that we might present in charts?

EDWARD T. PAXTON,
Bureau of Municipal Research and Reference,
University of Texas, Austin, Tex.

Following is a letter to Dr. Allen J. McLaughlin, U. S. Public Health Service, Washington, D. C., from Mrs. Charles Scheuber, chairman of the civic committee of the Federation of Women's Clubs, making a statement of the problems involved:

I am writing in behalf of the Federation of Women's Clubs to ask your assistance in the solution of a question of the gravest importance to the people of Fort Worth. As you doubtless know, Fort Worth is one of the rapidly growing cities of Texas with a population of 92,352. For the past twelve years the city has been supplied with water from an artesian system of water works owned by the municipality. As the city has grown the cost of operating the system has increased, owing to the greater depth from which the water has to be raised, to such an extent that the operation of the water works has been an enormous burden, in spite of the fact that the price of the water has increased to thirty cents a thousand gallons. Three years ago the city authorities were forced to the conclusion that they would have to find a cheaper water supply. Fort Worth has in its immediate vicinity several excellent sites for a surface supply of water by the construction of a dam. A site nine miles from Fort Worth on the West fork of the Trinity river was chosen, on which was constructed a dam covering three thousand six hundred acres of land and impounding 31,000,000,000 gallons of water. The dam has just been completed. This water is to be brought to Fort Worth by gravitation thru a closed conduit line and filtered by rapid coagulation thru the sand before it is turned into the water mains. Thru bad management, the conduit line has not been completed, and probably will not be in operation for a year. In the interval the dam is full to overflowing. The creation of a splendid body of water within nine miles of the city in this waterless section of Texas has at once aroused the feeling that here is a splendid opportunity for our people to enjoy boating, fishing and hunting. I have forgotten to state that to protect the dam the city has acquired about its shores two thousand four hundred acres of additional land in which many of our citizens see an opportunity for the city to reimburse itself for a portion of the outlay of $1,500,000 for the new water system by the sale of lots to citizens for country homes, etc.

The members of the Federation of Women's Clubs have been studying for some months the question of a surface supply of water. The object of the study was to assist in overcoming the deep antipathy of a great portion of our citizens to a surface supply of water on the ground that it is not pure, nor can it be rendered entirely safe by any system of filtration. As they studied the subject they were convinced that a surface supply of water can only be rendered safe by the utmost vigilance, and that the main requisite is to keep the source of supply pure. Therefore, they were astounded when they learned that the City Commisioners were going to consider the question of permitting the citizens to place boats on the dam, and that the question of selling the land on the shores of the dam for building sites was being seriously considered. They at once prepared the petition, a copy of which I enclose, and got the Board of Health to also file a protest. Final action on the question was postponed, and in the interval the city attorney was instructed to prepare the ordinance governing the use of the dam in acordance with the protests, the ordinance to be re-submitted to the Board of Commissioners when drawn. The protests of the Board of Health and Federation of Women's Clubs are being ridiculed on the grounds that the West Fork drains 2,000 square miles of territory on which are the following towns: Springtown, 24 miles from Fort Worth, population 350; Decatur, 36 miles, population 1,651; Bridgeport, 40 miles, population 2,000; Jacksboro, 56 miles, population 1,480; the density of population on watershed including towns is from 18 to 45 per square mile; that Decatur, Bridgeport and Jacksboro empty their sewage into the West Fork, and, therefore, it is worse than absurd to protest against the shores of the dam passing into private ownership, and to suggest that the dam be patrolled and people only be permitted to drive thru; that if the filtering plant can purify the water from the contamination which the city cannot control, it can also remove the additional deleterious matter that would be injected into it by the use of it for boating, hunting and fishing purposes, and by the sale of the land for a hotel site and residential purposes. The federation's stand is that a body of water as large as Worth Dam will not purify itself measurable from the uncontrollable contamination, and that instead of adding deleterious matter, every effort should be made to control the source of possible contamination, and that the possible contamination from using the shores of the dam for residential and camping purposes is very much greater than the sewage from Decatur, 36 miles away. We believe that a surface supply of water can only be made safe by eternal vigilance, and that not any city has any right to take the slightest chance in anything which so intimately affects the health of the people as a water supply. We also believe that it is most fortunate that the conduit line is not finished, since, while the dam was under construction for a period of two years, several hundred men were camped on the site of the dam without the slightest sanitary precautions having been taken; therefore, we feel that it is well that there will be this interval before the water can be used, to permit it to purify itself. Our authorities, if anything, should err on the side of caution if they desire the people to use the water, for, as a rule, the people are afraid of a surface supply of water, and, rather than use a water they are afraid of, will burden themselves by purchasing artesian water from privately owned wells for domestic purposes. But of course the only object of the members of the Federation of Women's Clubs is to serve the best interest of the people, and if they are mistaken in the stand they have taken, and the dam can be used for hunting, boating and fishing, and the land for

camping and residential purposes, they will be very happy to recede from their position.

I hope you will be able to help us by frankly stating just what you think would be the best plan for the Board of City Commissioners to pursue to protect the interest of the people of Fort Worth. I trust you will pardon me for troubling you with all this detail.

Following is Dr. McLaughlin's reply:

I have some hesitancy in rendering an opinion upon a special problem existing hundreds of miles away, but on points of general policy in safeguarding water supplies raised in your letter, I am very glad to give my humble opinion.

In spite of the fact that a purification plant is provided, all avoidable pollution should be kept out of the source of supply. The degree of purity of the raw water regulates your margin of safety, and this priceless margin of safety should not be thrown away for the financial advantage of some real estate exploitation.

I enclose a paper submitted by me to the International Joint commission for their information upon what constitutes a safe drinking water.

This paper brings out the limitations and fallibility of even the best filter plants, and the necessity of a decent margin of safety.

The results of placing an unreasonable burden or responsibility upon a filter plant are brought out also.

It is bad enough to be compelled by circumstances to struggle with a bad raw water, but to deliberately permit a good source to become a dangerous one is unpardonable.

Your letter is so sane and sound that I have little to add, except to advise you stick to your guns. If such an unthinkable result as losing your fight should follow, be careful to fix the responsibility for ruining your water supply squarely on the shoulders of the guilty parties. They must assume the responsibility of the passive murder which will follow the placing of an unreasonable burden upon your filter plant.

The same question arose many years ago with reference to the water supply of Rochester, New York, taken from Hemlock Lake, a larger body of water than Worth Lake, a natural lake and quite deep. The lake is a summer resort for Rochester people. There was soon much complaint of the liability of pollution of the water supply by the drainage from the cottages, boarding houses, hotels and restaurants on the banks of the lake and even over the water. Since the expense of the purchase of the land bordering the lake was prohibitive, the aid of the State Board of Health was sought and rules for the government of the watershed of the lake were established. These required that all human excreta and dangerous matter, including garbage and refuse, should be deposited in water-tight receptacles and that earth closets should be used in place of water closets, the apparatus to be supplied by the owners of the property. The city of Rochester was required to collect all this refuse at regular intervals and keep a boat running during the time the lake was not frozen, which takes the collections and disposes of them in a safe place. The water is not filtered.

The same question arose with respect to the water shed of the Croton river, which formerly supplied all the water for what is now the boro of Manhattan, New York City, and similar rules were promulgated after a careful survey of the sources of pollution of the water and study of the methods of preventing it. The city has spent many thousands of dollars in securing the enforcement of these rules and paying expenses justly chargeable to the city in connection with the work of removing and preventing pollution. This water also is not filtered. The area of the water shed is great and the tendency toward increase in population, tho slow, is irresistible, and the filtration of the entire supply is now proposed as an additional precaution to remove the small but slowly increasing amount of pollution now reaching the water.

It is true that many cities depend upon filtration to remove pollution from river water supplies and lake supplies, but the writer is not acquainted with any city which has deliberately added pollution to its water supply beyond that which it normally contains. On the other hand, cities are frequently changing their sources of water supply when the existing sources become polluted beyond a safe limit, or are adding the most efficient filtration and treatment plants obtainable.

No sanitary engineer would recommend the plan of populating the shores of the lake, particularly if the property is sold and the control of the situation passes from the city, even tho he must admit that the best modern methods of treatment of water are extremely efficient in removing such pollution, because there is always the danger of a break-down or a leak or of careless or malicious mis-management of the plant which would result in a serious epidemic of disease in the city, and the engineer is unwilling to take the responsibility for the consequences of such a break-down or failure of the system.

The reports of the State Boards of Health of Massachusetts, New York, Ohio and Pennsylvania in particular, and of several other states in less degree, have data regarding such sources of pollution and their effect, which could be put into graphic form to show what the dangers are. The work of the Massachusetts Board runs back over thirty years, that of New York for about thirty years, and that of Ohio for some twenty years. There are also some special studies of Chicago, Cleveland, Cincinnati, Louisville, St. Louis and other water supplies, of the Illinois, Mohawk, Hudson, Allegheny, Ohio, Mississippi and other rivers which would be of interest.

Can any of our readers point out a specific instance similar to the subject of this inquiry?

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## Resurfacing Old Brick Street with Asphalt

There is a brick paved street, 20 years old, here, that needs re-paving and a controversy has arisen whether it can be resurfaced without disturbing the old brick pavement with a sheet asphalt pavement. Eighty to ninety per cent. of the old pavement is out. The rest represents holes and depressions. Has not this resurfacing been tried in the west, particularly, viz., Toledo, Columbus, Cleveland, and Detroit with success? I can reach a file of the Magazine in the library.

M., ———, N. J.

An early article in MUNICIPAL ENGINEERING, giving details of the method of resurfacing a brick street in Decatur, Ill., with asphalt, will be found in vol. xxiii, p. 77. Portions of Sheridan boulevard, Chicago, Ill., originally paved with brick and with macadam ,were resurfaced with asphalt, as noted in vol. xxxv, p. 111. Resurfacing of old granite block streets in the boro of Manhattan, New York, of macadam in the boro of Brooklyn, and of brick in Bloomington, Ill., is referred to in vol. xxxiv, p. 361, where some of the difficulties in the process are suggested. The method used in St. Joseph, Mo., in resurfacing brick streets with asphalt, is given in vol. xliv, p. 153; in Memphis, vol. xlv, p. 104. A method of surfacing both old and new brick streets with a thin coating of asphaltic materials, as used in Minneapolis, Minn., is given in vol. xliv, p. 336. The details of the method of resurfacing macadam streets with asphalt, used in Chicago, Ill., are given in an illustrated article in vol. xlvii, p. 263. The new fibered asphalt pavement is described briefly in vol. xlvii, p. 234, and more in detail in an illustrated article in vol. xlviii, p. 292. An old brick street in Charleston, W. Va., has been resurfaced with fibered asphalt since the date of that article and is reported to be very satisfactory.

Will our readers give further references to both successful and unsuccessful jobs of resurfacing old pavements with new asphaltic tops of any kind?

# WORKERS IN THE FIELD

## A Trench Tamper or a Soldier

The Editor of MUNICIPAL ENGINEERING:

Sir—We are sending herewith cartoon as appeared in the *Ohio State Journal* under the caption: "From Out My Window." We are pleased to note that the cartoonist obtained his inspiration from some contracting job and not from work done by this department, as we use mechanical tampers as described in our article which recently appeared in your valued publication.

Herewith we are enclosing photo showing our "P. & H." tamper at work. This machine does the work of sixteen men and it never tires, stops to converse or "soldiers" on the job.

W. A. KELLOGG,
General Foreman of Water Works, Columbus, O.

A TRENCH TAMPER THAT DOES NOT SOLDIER.

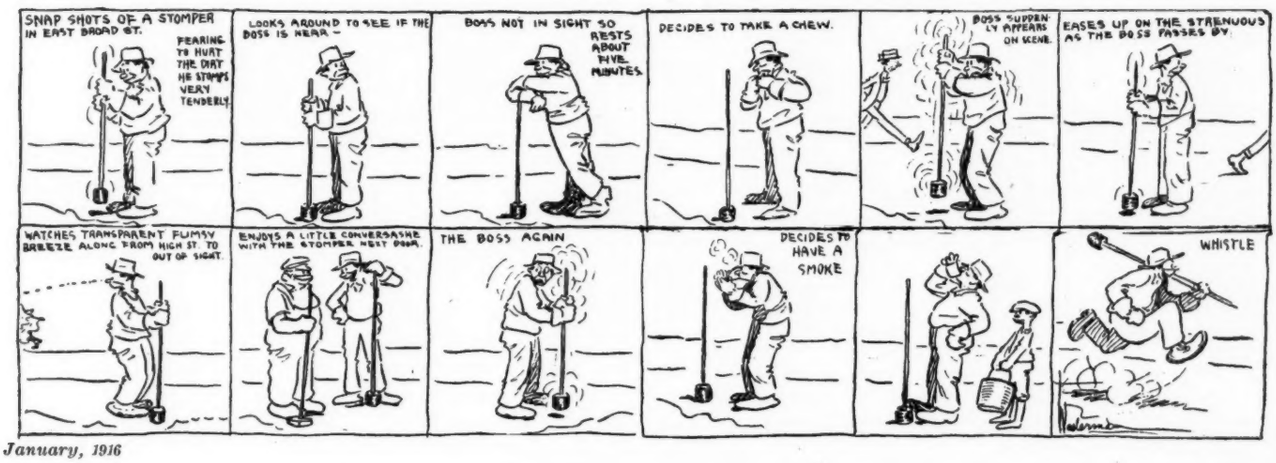
## Electrolytic Sewage Treatment in Boro of Queens, New York City

The Editor of MUNICIPAL ENGINEERING:

Sir—An article on the "Treatment of Sewage with Electricity and Lime," appearing in December number of MUNICIPAL ENNGINEERING, has come to my attention. There are certain statements made in this article which easily may result in decidedly wrong conclusions being drawn by readers not familiar with actual conditions.

The first statement to which I take exception is that "as a result of the favorable results in the small plant" these further experiments were conducted. About a year ago, while connected with the New York Bureau of Municipal Research, I conducted a series of tests made on the small test unit installed by Mr. Landreth at Elmhurst. These tests were conducted in co-operation with the Bureau of Sewer Plan of the Board of Estimate and followed the presentation of a report by Mr. Travis and Dr. Firth, of the boro of Queens, to the Board of Estimate, together with a request from the boro president for funds to install a plant of this type at Elmhurst.

While the Bureau of Sewer Plan, so far as I know, has never made a public report of these tests, the New York Bureau presented a report of its findings to the Bureau of Sewer Plan,


SNAP SHOTS OF A STOMPER IN EAST BROAD ST.
FEARING TO HURT THE DIRT HE STOMPS VERY TENDERLY
LOOKS AROUND TO SEE IF THE BOSS IS NEAR —
BOSS NOT IN SIGHT SO RESTS ABOUT FIVE MINUTES
DECIDES TO TAKE A CHEW.
BOSS SUDDENLY APPEARS ON SCENE.
EASES UP ON THE STRENUOUS AS THE BOSS PASSES BY.
WATCHES TRANSPARENT FUMSY BREEZE ALONG FROM HIGH ST. TO OUT OF SIGHT.
ENJOYS A LITTLE CONVERSASHE WITH THE STOMPER NEXT DOOR.
THE BOSS AGAIN
DECIDES TO HAVE A SMOKE
WHISTLE

CARTOON *appearing in Ohio State Journal, Columbus, O., referred to in letter from Mr. W. A. Kellogg, general foreman, Columbus water works, Columbus, O.*

to the boro of Queens and to Mr. Landreth. Inasmuch as this report has been made public, I feel at liberty to call your attention to its contents.

In the first place, the process was condemned principally on the basis of cost, altho we were unable to prove that the electrolytic treatment produced any better results than were accomplished by treatment of the sewage with lime alone and the same amount of agitation.

Waiving, however, the question of the degree of purification attained, which, in my opinion, is, after all, of only secondary importance, the question of cost has not yet been satisfactorily answered. The costs cited in the article in question do not include two very important items. First, no account is taken of the cost of the plant. As quoted me a year ago, the price of the machine was $15,000.00 for one 1,000,000-gallon unit. Sedimentation tanks also must be included, as must a "reserve unit." Second, while the cost of pumping is included in the $65.00 cost per million gallons quoted as the operating cost of the old plant, it is not included in the estimates for cost of electrolytic treatment. Furthermore, altho I made rather an exhaustive study of the operating costs of the old plant, I cannot account for the $65.00 rate without also including interest and depreciation on the building and equipment, including one acre of sand filters, of which no mention is made in the article.

While it is true that the cost of treatment under the old conditions is of minor importance, nevertheless, unless a true comparison is made, to include all cost items, no fair statement of facts is made.

It appears that even if the cost per million gallons can be accepted as $22.28, it is still considerably higher than the cost of other treatments. The explanation made that the degree of purification is greater than is obtained from other methods does not altogether over-balance this excessive cost. It is only on rare occasions that the degree of purification which is claimed for this process need be reached. Under ordinary conditions the purification gained by treatment with the older and well-known methods is sufficient. While the "result of the operation of the electric current is different from that of the application of hypochlorites," nevertheless, if a sterile effluent is necessary the application of hypochlorites will produce the desired result. The mere statement that the results are different does not explain why the additional expense is advisable. A cost of $5.00 to $8.00 per million gallons is considerably different from a cost of $22.00 to $35.00 per million gallons, for a three-million-gallon plant.

From my acquaintance with the plant at Elmhurst and the conditions of flow, I feel sure that during these later experiments sufficient attention was not paid to the irregularity of flow and the consequent variation in the strength of sewage treated. I have on my desk a copy of the report of which your article is an abstract. The tests were made in the majority of cases in the forenoon. Experience in former tests shows that the sewage becomes very dilute after 2:30 in the afternoon and continues so until the morning sewage arrives again. It is a well-known fact that the stronger the sewage the better the comparative results of any chemical treatment which includes sedimentation.

Another point which has not been treated satisfactorily is sludge disposal. The statement is made that the sludge produced by this process is about the same as that produced by chemical precipitation. This is true in the main, providing equal quantities of lime are used in both treatments. The sludge produced by the electrolytic treatment, however, is more bulky than that produced by ordinary lime treatment. The fact that the relative stability of the sludge is greater that that of ordinary sludge does not answer the question of how the bulk is to be disposed of. Once it has been pressed or dried, it still remains to be carted away. It is my opinion that the amount of sludge produced under this treatment is somewhat greater than that produced by the lime process, but I am willing to grant that the amount may be the same, still its ultimate disposal remains a troublesome question, as always, in any plant where sedimentation is a part of the treatment.

While talking with Mr. Landreth about a year ago, he made some rather remarkable statements to the effect that this sludge could be turned directly into a stream or water shed without creating a nuisance. I was unable to convince him at the time that the greatest nuisance which could possibly arise would be the filling up of the waterway. Stability has nothing to do with the filling qualities of the material

The statements in the article regarding the former unsatisfactory method of sludge disposal appear to be irrelevant to the subject of the report. The former methods were far from efficient. In fact, the entire plant was recognized as being antiquated and utterly unsuited to present demands. Consequently, any comparison made between the old plant and any type of new modern plant would be equally as glaring.

In closing, I feel sure that it was not the intention of MUNICIPAL ENGINEERING to cause any misconception to arise in the minds of those not fully acquainted with the facts. It is for this reason that I have taken the liberty to call your attention to some of the wrong impressions which might easily arise from a reading of this article.

JAMES W. ROUTH,
Engineer, Rochester Bureau of Municipal Research,
Rochester, N. Y.

The first article on this subject in MUNICIPAL ENGINEERING appeared in October, 1914. Attention was called in the introduction to the article, vol. xlvii, p. 279, and in an editorial on p. 287, to the lack of sufficient data as to cost. The article in the December number, vol. xlix, p. 222, contains some additional figures which evidently do not include the overhead charges and must therefore be recognized by the reader as incomplete. The statements in the above letter regarding the inaccuracy of the comparison with the old plant are very welcome.—[EDITOR.

## Engineers and Military Preparedness

At its annual banquet on December 2 the Brooklyn Engineers' Club heard a discussion of military preparedness by Gen. Leonard Wood, Admiral N. R. Usher, Elmer A. Sperry, Commander Jessup and Captain Kilbourne. William Barclay Parsons announced that the committee of civil, electrical, mining, mechanical and consulting engineers, of which he is chairman, prepared a bill to submit to Congress in December providing for the creation of a reserve corps of engineers.

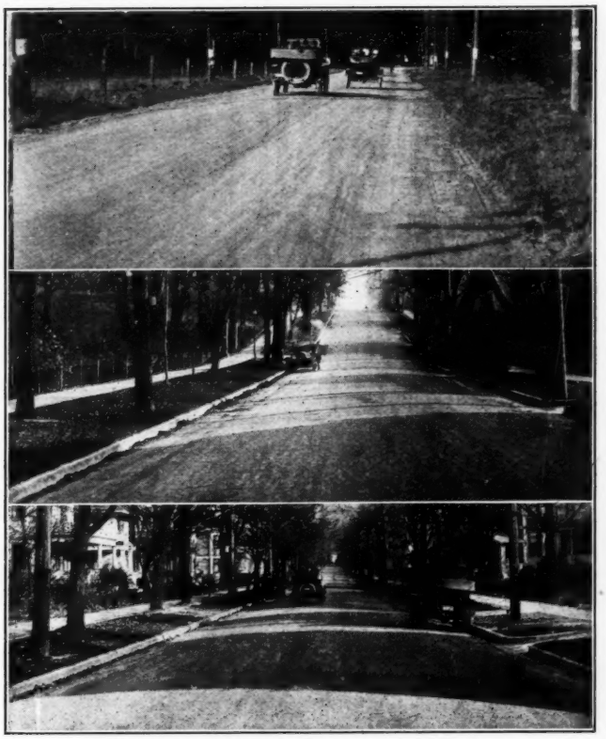
## Calcium Chloride on Gravel Roads

The Editor of MUNICIPAL ENGINEERING:

Sir—Your letter regarding calcium chloride for the treatment of gravel roads in the vicinity of Grand Rapids has been referred to us, as we made the application on these roads, as well as on miles of gravel streets in the city.

The twenty-five miles treated for the Kent County Road Commission received one pound per square yard about the 1st of July, at a cost of ¾ cent per yard, 9 feet wide, and are today in splendid condition, as calcium chloride draws moisture from the atmosphere and thus acts as a binder, moisture, as you know, being absolutely necessary to bind a gravel or macadam road.

The principal thorofares in the city have depended on calcium chloride for the entire season, and all such streets are now hard and in splendid condition, while those sprinkled with water are full of holes and minus the dust binder, thus leaving the gravel in a loose condition.



A COUNTRY ROAD *near the Soldiers' Home, very heavily traveled, and supposed to have been beyond redemption, as it was impossible to keep the road from being picked up by the automobiles. A treatment of calcium chloride has kept it dustless and a perfect driveway. The machine in the picture was going about twenty miles per hour when the picture was taken.*

THIS STREET HAS A SIX PER CENT. GRADE. *It has had two treatments a season, and while the street was in very poor condition, calcium chloride caused the same to be packed, and kept the rains from washing the street. This was an experiment, as the heavy rains and the steep grade might have caused the calcium chloride to be washed out. The street has been recently resurfaced and given a treatment of calcium chloride, as the first proved so successful.*

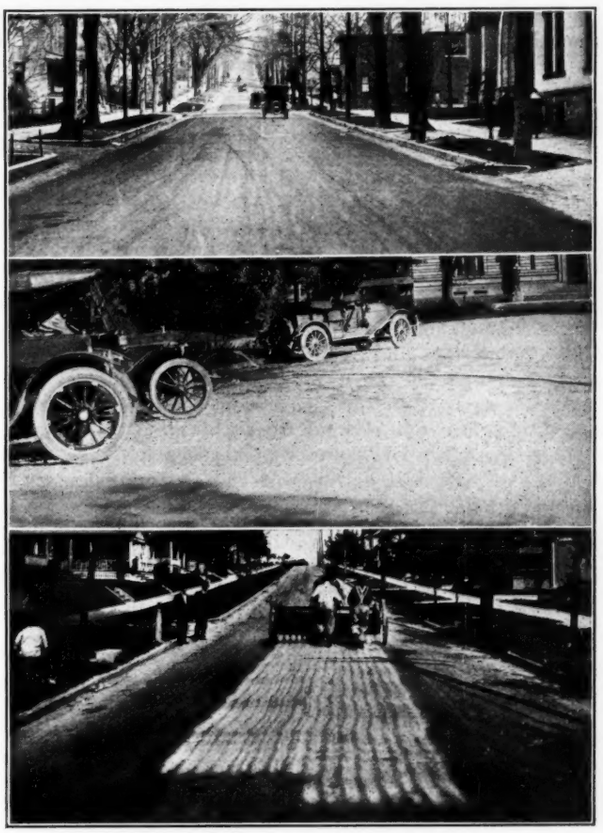
THIS STREET WAS FULL OF HOLES *caused by the constant sprinkling, water standing in the low spots, keeping them mushy and continually growing larger. The street was scarified by placing four-inch spikes on a road roller, then two pounds of calcium chloride per square yard was raked into the gravel, sprinkled and rolled. This was done at a saving of $100 per block over the old way of hauling on 75 loads of gravel to eliminate the chuck holes, the calcium chloride making it possible to bind the old gravel. This work was done in June, has had no sprinkling since, is dustless and in a most perfect condition.*

The street repair department has also found it a great money-saver in rebuilding the gravel streets, which are full of chuck holes caused by the constant sprinkling with water, by scarifying the street and raking in about two pounds of calcium chloride to the square yard, and then rolling, which saves at least $75 per block over the old way of hauling on more gravel and clay. The streets thus repaired are the best we have in the city, and are standing the travel without any sign of wear.

While the calcium chloride applied to a street or road after it is finished is of great value, my two years' experience in making the application, both in this way and in using it in building the road, has convinced me that the best time to use the same is in building the road, which makes it hard and firm to the bottom. The calcium chloride used was furnished by the Semet-Solvay Company, Syracuse, N. Y.

We are sending you photographs of some of the roads and streets treated.

WYKES-SCHROEDER COMPANY,
Grand Rapids, Mich.



THIS STREET WAS RESURFACED *three years ago with three inches of macadam, and after four weeks had lost one inch of surface, the sprinkling cart passing over same three times a day. An application of calcium chloride has kept the street dustless the entire season, thereby keeping the street from blowing away, and same has had no sprinkling cart since that time, but has been kept in perfect condition with calcium chloride treatments at an expense of one cent per square yard per season.*

THIS STREET WAS RESURFACED *with loose gravel, which traffic did not bind, and after two weeks calcium chloride was applied to one side of the street, which caused it to pack within three days. The part of the street not treated is still loose, as the photograph shows.*

THE SPREADER *used in applying calcium chloride is an ordinary lime spreader and can be purchased from any implement dealer for* $50.

# LEGAL DECISIONS

## Decision of Suit on Reinforced Concrete Arch Patents

As noted in the editorial department, a decision has been rendered against Luten patents on reinforced concrete arch designs. Judge Robert E. Lewis, of the U. S. district court, Colorado district, made the decision in the case of Daniel B. Luten vs. Geo. Washburn et al., based on seven of the Luten patents. It differs from prior decisions in that it draws a definite distinction between the exercise of inventive genius and the "application of mere mechanical knowledge and skill," claiming that the latter does not entitle an applicant to a patent unless it clearly involves the former. Whether the decision is right in the present case or not, this principle, if applied generally, will clear up the patent situation materially in the future at the same time that it opens the way to many mistakes of judgment in favor of and against patentees according to the circumstances of each case. Some extracts from the decision will indicate the line of reasoning followed by the court.

"On consideration of prior patents and publications introduced by the defendants to meet the separate and several claims, I am unable to rid myself of the firm belief and conclusion that each and all of complainant's claims were nonpatentable at the time he made his several applications. The prior patents as anticipations and the prior patents and publications as showing the then state of the art lead to the clear conviction that complainant in each instance only then made application of mere mechanical knowledge and skill, and that what he did is in no sense a demonstration of inventive genius. This is also the opinion of the defendants' expert witness.

"The complainant as a witness disclaims that his patents or any of them, embodied anything beyond or more than placing the steel in a new way that produces better results in a more efficient form. Now in a concrete bridge the greatest efficiency is always secured by resisting tension or pull with steel rods. That has been established for half a century; not perhaps with curved tension members, but the basic idea is very old.

"But none of complainant's patents in its specification, including drawings, and in the claims gives any specific direction as to just where any of the reinforcing members should be placed. This, I suppose, would in each instance depend upon the maximum load to be carried, the length of the spans and other elements which involve mechanics only, and would necessarily, I assume, be worked out in determining the amount of compression and tension under the established formulae in statics. In a general way, the points of greatest stress can be roughly approximated without the use of mathematical tables, but this is centuries old; that is, it is open to common observation, and the fundamental purpose of reinforcing concrete was to strengthen the structure at these points; such a discovery in Luten's day is no evidence of inventive genius.

"A bridge girder, for instance, is commonly known to be in compression on its upper side and in tension on its lower side; hence the greatest necessity for them thru the latter region, and if carried continuously thru and anchored in the outer face or foot of the abutment, it is but adding the element of suspension in bridge construction, which is old. This but illustrates. The same applies to the other points relied upon in Luten's patents.

"I see nothing more than mechanical skill in tying the wings and abutments together, the circular knee-brace, in the outer girder with a reinforcing member, binding it to the adjacent abutment and girder and in carrying the transverse member in the roadway into the outer side of the upper spandrel or girder and upward and over the longitudinal reinforcing member in that girder. In view of the Coignet letters and of the prior state of the art as evidenced by his patent, and the publications introduced as above noted, he made specific claim to a 'metallic frame-work linked or arranged so as to strengthen the same.' "

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## Decisions of the Higher Courts of Interest to Municipalities

STATE BOARD OF HEALTH CAN ORDER SEWERAGE SYSTEM.

While the power to tax is inherently a legislative function, which can be delegated only to municipal corporations, Acts 1914, c. 810, §§ 7, 9, authorizing the state board of health to require counties and cities to establish sewer and drainage system, is not invalid as an improper delegation of legislative authority; for it does not give the board of health authority to determine in what manner the improvements shall be paid for, but leaves that to the counties and municipalities.

The reasonableness of the exercise of the power to require the establishment of sewers and drains conferred by Act 1914, c. 810, upon the board of health is open to question and is expressly made so by section 18 of the act.—Welch et al. v. Coglan et al. County Commissioners (Baltimore Co., Md.), 94 Alt. 384.

DAMAGE FROM DEFECTIVE CURB CONSTRUCTION.

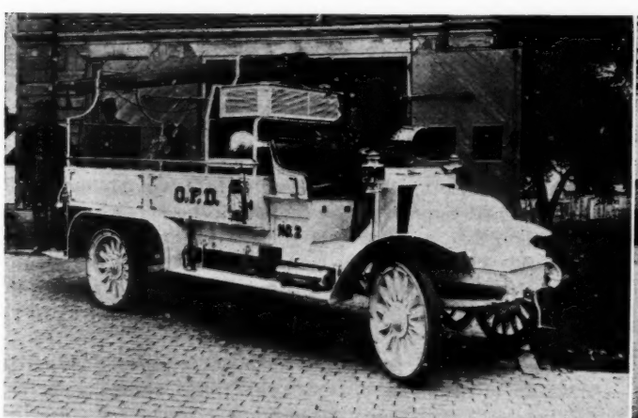
A pedestrian, stumbling over a curb curving round a corner, defective by reason of the presence of an iron band bent around the curb to protect the stone from vehicles and extending about an inch above the curb, which extended nearly six inches above the sidewalk, was not as a matter of law guilty of contributory negligence merely because he had observed the walk at other times, for where a defect is not of such a character as to show it to be so unsafe or dangerous that a prudent person in the exercise of ordinary care would not venture over it, a pedestrian in the exercise of ordinary care, who is injured in passing over it, may recover.—Bullard v. City of Independence (Mo.), 176 S. W. 1066.

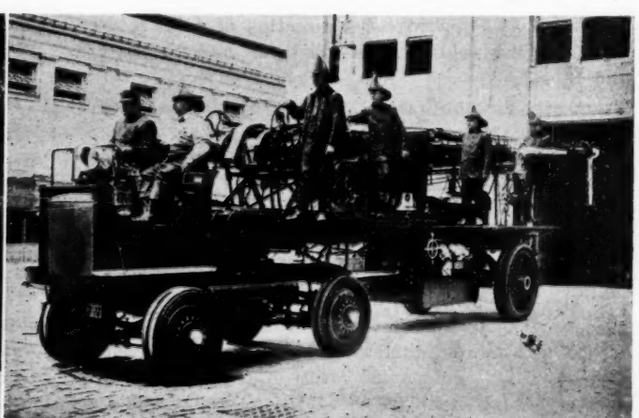
# FIRE DEPARTMENT

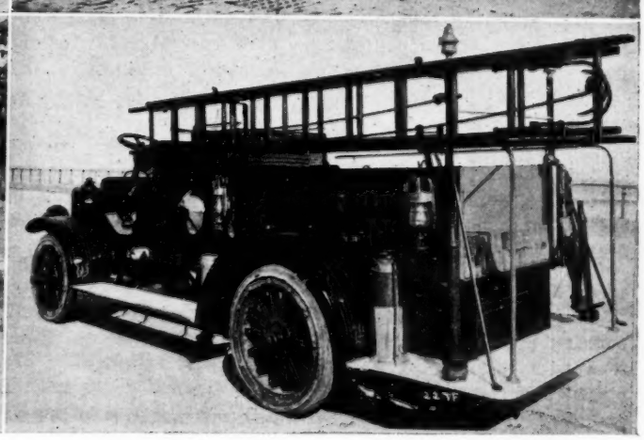
## Motorization Effects Big Savings in New York Fire Department

"Seventeen thousand dollars saved in maintenance of apparatus has been set aside to buy four motor fuel wagons," states Mr. Robert Adamson, fire commissioner, city of New York. "These four motor fuel wagons will replace eleven horse-drawn wagons, releasing when in service seven more firemen, salaries $9,800 a year, and saving $15,400 in upkeep. Seventy-six new pieces of motor apparatus were added to our equipment, 27 hose wagons, 42 tractors and 7 combination hose and chemical wagons. To be able to organize twenty new fire companies and otherwise to extend the work of the department, while at the same time cutting the budget for 1915 $65,110.80 below the figures of 1914, means in itself a clear saving in administrative cost of almost half a million dollars. These changes were merely bringing the department up to date. Motorization has greatly increased the rapidity of operation of the fire companies and extended their radius of operation. It was only natural that the city should reap some advantage from the greatly-increased speed and efficiency that have come with the introduction of motor apparatus, high-pressure service and other mechanical improvements.

"On December 31, 1913, there were 1,341 horses in the department and on December 31, 1914, only 1,167. Contracts were let during the year for 76 pieces of motor apparatus to take the places of the horses retired. Forty-two pieces of

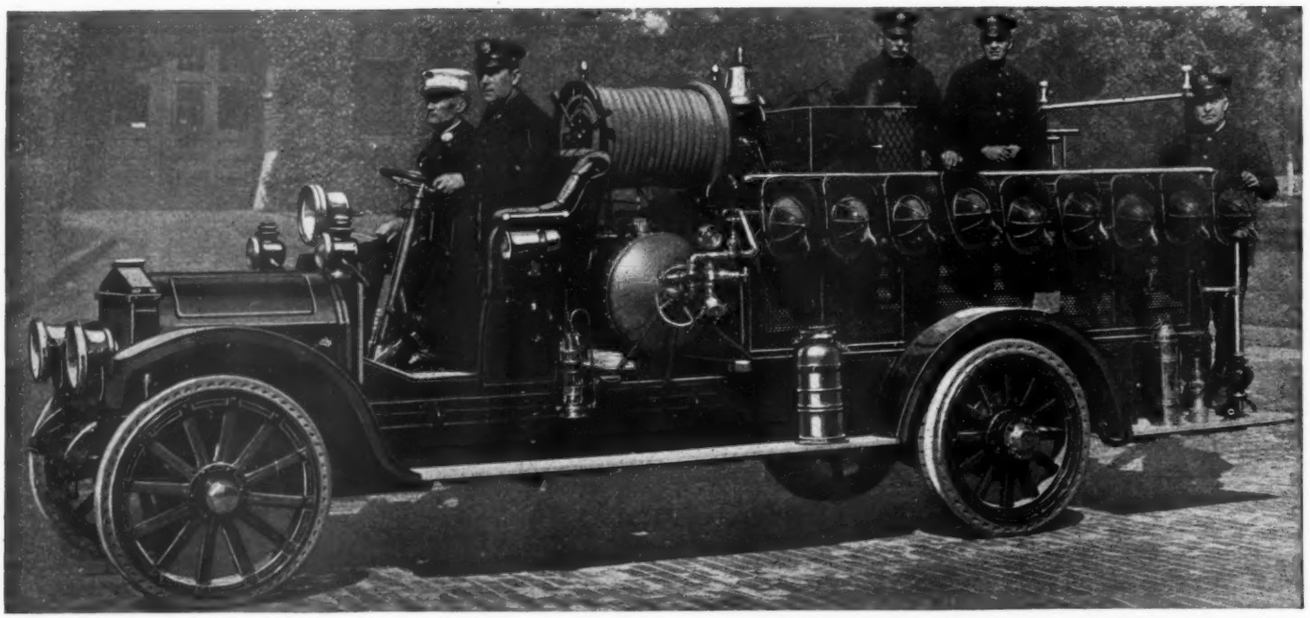




ADAMS COMBINATION, OLEAN, N. Y.
SOUTH BEND POLICE PATROL, CITY OF GARY, IND.

COUPLE-GEAR WATER TOWER, PHILADELPHIA, PA.
GRAMM-BERNSTEIN COMBINATION, WILDWOOD, N. J.



FEDERAL *Combination Hose and Chemical, City of Albany, N. Y.*

this new apparatus are tractors, each one of which represents a saving in maintenance as compared with the horse of $480 per year, $20,160 a year for all. On the 27 motor-propelled tenders installed there will be a saving in maintenance of $280 per year on each. It is recommended that sufficient funds be provided to complete the motorization of all fire apparatus by the end of 1917, according to the schedule fixed by this department.

"The purchasing division of the Bureau of Supplies and Repairs, which is under the direction of John R. Keefe, lists the following contracts awarded for motor apparatus, 1914 and 1915:

| | |
|---|---|
| Two-wheel gasoline tractors for fire apparatus | 42 |
| Motor-driven hose wagons | 27 |
| Motor-driven combination chemical and hose wagons | 7 |
| Gasoline pumping engines | 5 |
| Total | 81 |

*Specifications Mean Gasoline Saving.*

"Tho an increase of only 20 firemen was allowed for 1914, these for the fireboat Gaynor, and tho it was understood funds would be requested during the year for men for the new companies, 3 new companies were organized May 15 and December 31, last, without an additional dollar being asked for, the necessary men being procured by revocation of details and by re-location of companies, due to a careful study of the effect of motorization. Four fire companies, 5 sections and 6 small combination hose and chemical companies, shown by careful study to be no longer needed at their old locations because of motorization and changed conditions, were discontinued, thus releasing for new companies 8 captains, 8 lieutenants, 4 engineers and 93 firemen, with total salaries of $164,000 and apparatus valued at $64,000. New gasoline specifications resulted in a saving of $6,000."

*Converted Water-Tower.*

The Couple-Gear water tower, shown in one of the accompanying photographs, was originally hauled by horses. The forward axles and wheels were removed and the forward end placed under the fifth wheel, which is carried in the tractor frame. The tractor is a standard gas-electric type with a gear ratio of 19 to 1 in the driving wheels. Each of the wheels is equipped with dual 4x36 hard rubber tires, and each contains a double duty 3-h.p. motor. The generating outfit consists of a 5¾-inch by 6-inch stroke, 4-cylinder, 4-cycle engine, direct connected to a 13-k.w. generator. The wheel base of the tractor is approximately 100 inches, and speeds with the tower attached range up to twenty-five miles per hour.

## A Gramm-Bernstein Combination Hose and Chemical

In the accompanying group of four photographs is shown a Gramm-Bernstein combination hose and chemical furnished to the city of Wildwood, N. J.

The following terse description of the combination may prove of interest: Extra heavy solid brass piping connects the chemical tank with the automatic hose reel. The piping contains 2½-inch intake connections and the valves are so arranged that water may be taken from the hydrant and be run either into chemical tank to refill it, or thru the chemical hose, or both. A pressure gage is so situated as to show the pressure in the hydrant or in the tank.

The rear axle is of the worm-driven semi-floating type. Housing is made up of one piece steel casting; axle shafts 3½ per cent. nickel steel properly heat treated.

The transmission consists of three speeds forward and reverse, selective, with gears always in mesh. Different speeds are engaged by sliding dog clutches. Direct drive on third speed. Gears and dogs and shafts are all made of chrome nickel steel. The main shaft is made up with six splines milled in the solid shaft. Gears have 1-inch face and 5 pitch. All gears and shafts operate on annular ball bearings.

This company also builds tractors and triple combinations. The triple is larger and stronger than the combination and the motor is a great deal larger, with a pump in rear of chassis to handle two and four streams.

## An Adams Chemical and Hose

One of the accompanying group of four photographs shows an Adams combination chemical and hose wagon, model D chassis, in the service of the fire department of Olean, N. Y. This outfit is painted white thruout and striped in gold; all brackets and hangers are of brass.

The body is 10 feet long, 5 feet wide and 16 inches high, made of first-class hardwood, with plain panel sides, and the seat extending the full width of the body.

This truck has the following equipment: 40-gallon Champion style chemical tank; 210 feet of ¾-inch chemical hose, complete with couplings; 8-pound flat head fire ax; 8-pound pick head fire ax; crow bar, fire department style; two Ham cold-blast firemen's lanterns, brass polish; two nozzle holders, attached to rear step; extension ladder, solid side rope and pulley, rapid hoist, 25 feet long when extended, 12½ feet long when closed; prest-o-lite tank; search light, with electric starter; two brass hand rails; two oil side and tail lamps; set of tools; jack; horn locomotive whistle; speed indicator.

## Low Costs Recorded by Dallas

Five machines, placed in service by the city of Dallas, Texas, November, 1913, have made a remarkable record, as follows:

Motor Truck No. 1—Total miles run per year, 4,327; average per month, 360 miles.

Motor Truck No. 2—Total miles run per year, 4,395; average per month, 366 miles.

Motor Truck No. 3—Total miles run per year, 4,133; average per month, 344 miles.

Motor Truck No. 4—Total miles run per year, 4,286; average per month, 357 miles.

The total cost of operation of these machines, including all garage expenses, gasoline, oil, grease, repair parts, extra fittings, etc., but not including depreciation on the cars, was as follows:

Motor Truck No. 1—Total expense for the year, $444.48; average cost per month, $37.04.

Motor Truck No. 2—Total expense for the year, $458.77; average cost per month, $38.23.

Motor Truck No. 3—Total expense for the year, $432.19; average cost per month, $36.01.

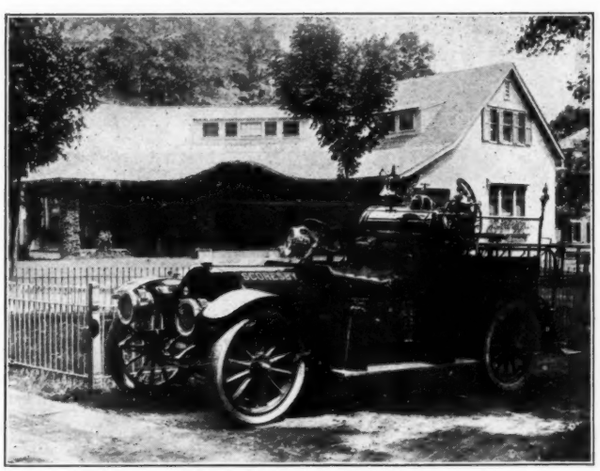
Motor Truck No. 4—Total expense for the year, $419.55; average cost per month, $34.96.

Motor Truck No. 5—Total expense for the year, $431.29; average cost per month, $35.94.

The average cost per mile, therefore, based on the foregoing and without including depreciation charges, amounted to approximately 11.5 cents.

## Fire Department Notes

The Scoresby hose and hook and ladder company, of Ellenville, N. Y., have built and own the handsome club house shown in the accompanying photograph. It is the finest and most complete in the state. C. G. A. Fischer, the chief engineer of the department for the past two years, designed the chemical and hose apparatus shown in the picture and the company built it on a Kissel 50-h.p. truck chassis. Mr. Fischer has established building inspection, building laws and fire limits and reduced the fire loss more than 75 per cent. thereby. He has been in the department as fireman, foreman and chief for thirty years. The department has also three hose and one hook and ladder carts, hand-drawn.



Chief Samuel G. Cottrell of the fire department of Westerly, R. I., joined the Rhode Island Ones December 20, 1868, and has held office for practically the entire period either in the company or in the district. He was elected second assistant December 20, 1873, and continued in this capacity until 1880, being placed on the honor roll October 5 of that year. Chief Cottrell was elected to the board of engineers November 5, 1890, and served till 1899, when he was elected to fill the chief executive office of the Westerly Fire Department, a position he has had the honor of holding for the past fourteen years. By his untiring efforts he has been instrumental in bringing about results that have been beneficial to the community, which has one of the largest volunteer fire departments in the state of Rhode Island.

F. J. Purdy, Assistant Chief of Fire Department at Mitchell, S. D., was injured recently by being struck below the knee with an ax while attempting to cut thru the roof of a burning building.

An elopement of a San Bernardino fireman was stopped by an alarm of fire to which his company responded. In attempting to follow in her father's automobile, the young lady set fire to the machine, causing another fire alarm, bringing the young man and his fire company to the rescue. Forgiveness and consent to the marriage followed.

W. A. McOuat, chief of the fire department of Portsmouth, O., was a railroad engineer prior to 1909, when he joined the Portsmouth fire department as captain and engineer, moving up to chief of the department in 1914. The safety fund of the city is overdrawn, so that there has not been money enough to motorize the apparatus to any extent. Chief McOuat was the head of the entertainment committee for the convention of the Ohio Fire Protection Association, held in Portsmouth last September, and the members of the association are loud in their praises of the attention paid to their pleasure and profit.

A. J. Kienle has been chief of the fire department of Easthampton, Mass., since 1906, and started it on a program of evolution which resulted in 1913 in the consolidation of the two hose companies, on account of the purchase of a White combination hose and chemical automobile truck, and a Knox-Martin tractor was bought for the hook and ladder truck. Other steps in the evolution which are still in evidence are a firemen's relief association, an inspector of wires and superintendent of the fire alarm system, civil service rules for the department, the expansion of the fire alarm system to four circuits.

## The Street Cleaning Problem

*By Gus H. Hanna, Commissioner of Street Cleaning, Cleveland, O., Before the International Road Congress, at Worcester, Mass.*

I have been requested to come here and talk to you in detail and explain the object of the Association of Street Cleaning and Refuse Disposal Officials of the United States and Canada. This organization has been in contemplation for some time. Thanks to the efforts of Commissioner Fetherston and Secretary Buchanan, of the New York City street cleaning department, for their unceasing work and patience, it has now attained a growth which assures that branch of civic government an exchange of knowledge unsurpassed by any theoretical students of municipal problems. This is our main object; we hold that an interchange of ideas from practical men that have made our particular branch a study, not from theory and unfathomable figures, but from actual experience work, thus giving cities or hamlets the benefit of a vast field of knowledge that could not otherwise be obtained.

Street cleaning is not a romantic subject. It does not arouse the enthusiasm of citizens like new public buildings or similar work of construction. It is not so exciting as putting out a fire or suppressing a riot. It is less of a kid-glove job than caring for parks and playgrounds. Like woman's work, it is never done, but has to be repeated day after day and week after week.

The best street cleaning superintendent is the man you never hear about, because, if his work is done well, nobody ever thinks of him. If his work is neglected or badly done, he gets his name in letters an inch high on the front page of every paper. Yet, the street cleaning department is often the first agency of the city to feel the pruning knife, when it is necessary to cut down expenditures. That is how much glory there is in the street cleaning business. A street cleaner may save lives, by combatting unsanitary conditions, but he gets no hero medals and no monuments.

I am not complaining of my job. I am simply explaining in advance why certain facts of which I will treat have escaped general attention. For example, it is common to divide paving costs under two heads, the cost of construction and the cost of repair. I maintain that the cost of cleaning is fully as significant a factor as the cost of repairs and is entitled to equal consideration in deciding any question of paving policy.

The street cleaners' task is more directly reducible to a question of dollars and cents than is the paving engineers'. When a street is clean, it is clean and there are no degrees of super excellence to aim for. It must be the superintendent's continual study to effect this cleaning as cheaply as possible, both because the public grudges money for street cleaning and because, if there is sufficient money, what is saved in economical cleaning can be applied to more frequent cleaning. Therefore economy must be the theme of any practical discussion of street cleaning. I will try briefly to tell you the result of my experience in three elements of economy:

First, the cheapest method of cleaning pavements.

Second, methods of reducing litter.

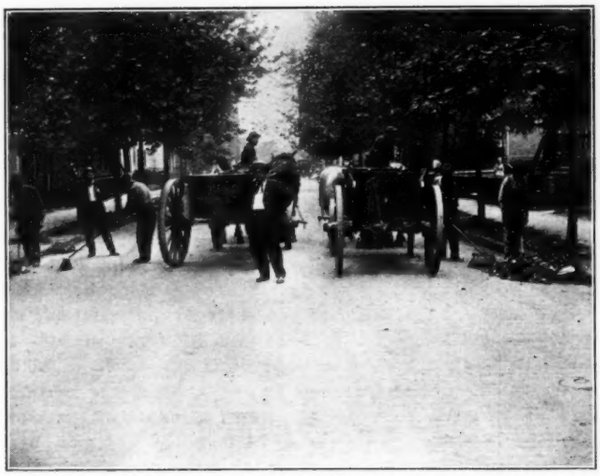
Third, paving policy with a view to saving the cost of cleaning.

The use of flushers has proven not only the cheapest, but the most satisfactory method of street cleaning that our experience in Cleveland has been able to develop. We still make a considerable use of hand sweeping, but to make my point clear I need only refer to the statistics of our department, which show an average cost of 15.3 cents per square of 10,000 square feet for flushing, to which must be added practically 9 cents for pick-up work, a total of some 24 cents per square as against 42 cents for the work of the white wings.

The white wing is too convenient and necessary an adjunct to be wholly displaced under any conditions. Down town streets must be swept continuously during the day and the hand sweeper, with his small cart, can also work to advantage in the gutters of residence streets, collecting dirt that has either been flushed or blown to the curbs. But so far as our experience goes, the lessening of cleaning cost by cheaper methods means simply the extension of the use of flushers at every practical point.

There is an argument of sanitation in favor of the flushing method of cleaning. Dust breeds infection and is ex-

AUTOMATIC FLUSHERS AT WORK.



COMMISSIONER GUS H. HANNA DIRECTING HIS PICK-UP SQUAD.

tremely unpleasant where it is not dangerous. Hand sweeping causes a certain amount of dust and mechanical sweeping usually causes still more. However, with all that can be said on this score, I am opposed to simple sprinkling as a means of laying dust. Ammonia and other products leach out of damp manure and form a scum on the surface of the street that is nearly impossible to remove and makes the pavement slippery and foul smelling. Water should always be applied with force enough to carry the refuse to the gutter, where it should be promptly collected with brooms and shovels and removed.

The prevention of litter in streets has been carried farther, perhaps, in more congested cities than has yet been necessary in Cleveland. Even in our most crowded quarters, the street and sidewalks are rarely used as locations for garbage and ash cans, so one fruitful source of trouble in certain eastern cities is minimized in our case. We are reasonably successful in teaching the public to use waste paper boxes, but there is always room for improvement in such works of public education. We have tried during the past year to organize volunteer corps among school boys and girls who will use their influence against the useless littering of streets. The success of the venture is still at issue.

On the long run, nothing encourages carefulness on the part of the public so much as efficient and careful cleaning. A man does not hesitate to throw paper or rubbish in a street that is already foul. He thinks twice if the street is neat and clean. If there is a waste box at hand with a printed word of suggestion on the outside, he is apt to use the box.

The greatest source of expense in Cleveland has come, not from those who use the street for traffic, but those who use it as a place of business. A few hundred square feet near a certain street corner cost our department $10,000 to keep clean during the year last past. It is the location of a curb market, supposedly a farmers' market, but really the resort of professional hucksters who dispose of provisions that have often become shopworn in adjacent market houses before finding their way to the curb. It would be a small return for the privilege of doing business in the street to require these hucksters to keep their surroundings clean at their own expense on pain of arrest or forfeitures of their privileges. My annual report recommends that some method be found of ridding the city of this form of imposition, and I think that if the principle is applied in most cities to their market districts it will result in a considerable saving of cost.

In certain localities the mud that is tracked upon pavements is the greatest source of cleaning cost. Paving policies should be carried out with a view to having a minimum number of unpaved approaches to existing pavements. I want also to point out the need of protecting narrow rural pavements from the overflow or tracking of mud that originates on adjacent portions of the same highway. Where half of a road is paved, care should be exercised to prevent the unpaved portion from draining across the paved portion. If the pavement is so narrow that teams must turn partly off from it at meeting points, the berms should be covered with broken stone or cinders to prevent tracking mud on the pavement. Few streets are so dangerous to auto traffic as a narrow suburban pavement with a film of fluid mud over it. The pitch frequently encountered on such pavements is enough when covered with slime to keep an auto continually skidding toward the curb. The cost of cleaning, under these circumstances, is higher than on other streets with ten times the traffic. With proper drainage a shower ought to be a means of cleaning, not a means of contamination for an outlying pavement, even tho it covers only a portion of the roadway.

But the foregoing measures are not so important or effectual in saving the cost of street administration as is the construction and maintenance of pavements that are easy to clean. It is a continual wonder to me that so little weight is given to cleaning cost when paving questions are settled. An annual expense of $500 a mile in repairing residence streets would be considered an appreciable item of maintenance, yet that figure for cleaning a mile of residence street thru a season is extremely low. A cost of $500 for maintaining a mile of one kind of pavement for a year as against a cost of $1,500 for maintaining another kind would be sufficient grounds, in most cases, to decide in favor of the former material. Yet greater differences than this in cleaning cost as between competing types, are blandly overlooked.

A street cleaner looks for two qualities in a pavement. It must be smooth and particles of litter must not stick to the surface. The question of smoothness opens up the whole matter of durability. Any material that deteriorates and roughens becomes more difficult each year to clean. Any neglect of needed repairs means a larger cleaning bill until the repairs have been completed. I do not think it is necessary for me to discuss the durability of materials. Many of you are authorities on that subject. I merely wish to emphasize one thought that should enter into all your calculations of expense, and that is the two-fold expense resulting from wear, the cost of repairs plus the increased cost of cleaning.

CLEVELAND WHITE WING.

Additional calculation of cleaning expense must be made for all bituminous pavements on account of the sticking of particles of litter to the surface. These surfaces are never quite so clean as non-adhesive materials and it costs from 25 per cent. upward in additional cost to put them in a reasonably presentable condition, on account of this quality.

This difficulty is seen at its worst in a new creosoted wood block pavement, when the oil is gradually working out between the pores of the wood. The use of steel scrapers must often be employed, as the flushing by water is not effective at all in removing the dirt from such a surface.

The substances most easily cleaned, that enter into pavements, are brick and stone. Neither of them originates any form of dirt and both wash off readily. The only ground for discrimination between them is on the question of smoothness, where brick has a slight advantage as a rule. But in the use of these materials, the choice of a filler is all important. A bituminous filler has all the disadvantages of a bituminous surface, from a cleaner's standpoint, and some others besides. Being softer than the brick or block, it recedes, leaving a crevice that invites the lodgement of dirt. With the edges of the brick or block unprotected, it is sure to roughen, thus adding to the difficulties of cleaning. In fact, such a street, after a few years, presents an array of cobble stones, with the filler invisible or else melted and run to the gutter where it impedes the work of the follow-up gang.

So what I say in praise of brick and block pavements is mean to apply only to those built with a cement grout filler. I regret that I must rely upon general observations rather than exact data in supporting some of my statements, but it happens that we have in our office the result of observations made upon West Fourteenth street, in Cleveland, with a view to determining the cost of cleaning. This is a grouted brick thorofare that has been paved some ten years and yet is in good enough condition to serve as a model of minimum cleaning cost. This street has a traffic of about two vehicles a minute. It has been cleaned, on an average, five times a week, being flushed by night and hand swept in the day time. The sweeper worked almost exclusively in the gutters, as most of the dust on such a pavement will be blown to the curbing in dry weather. The cost, per cleaning, amounts almost exactly to 15 cents per 10,000 square feet, which we call a "square" and use as our unit of calculation.

This is the lowest figure that we have been able to achieve on any type of pavement. The cost on the best asphalt pavement would not be less than 20 cents and would rise to 30 as the surface became wavy or rough. A wood block pavement costs practically a dollar a square to clean in its initial condition, and it will be at least two years before the oil will have dried out sufficiently to admit of its being cleaned for 30 cents a square. A tar-filled block pavement will cost not less than 30 cents per square, and, as the filler disappears and the block roughen, this cost will amount to 60 cents or more.

WEST FOURTEENTH STREET, CLEVELAND, OHIO.

So you can see how much weight I would put upon the question of cleaning cost in the selection of a material as well as its construction. In the case of a pavement forty feet wide, there are about twenty-one squares to the mile. As between a material that can be cleaned for 15 cents and one that can be cleaned for 30 cents, there is a difference of $3.15 per mile per cleaning, a difference of $15.75 per week, of $630.00 per season of forty weeks and $6,300 in ten years. And instead of 30 cents the cost of cleaning the latter pavement mounts to 60 cents per square, as is not uncommon under conditions of wear, the excess of cleaning cost being $1,800 for a year or $18,000 for a decade above the figures that we have shown to be attainable on West Fourteenth street. The successes of our department and the good sanitary record of our city are attributable in no small measure to the fact that we have miles of this type of brick pavement.

Cleaning costs can be greatly reduced by a policy of prompt repairs. I believe in the continual patrol of all city streets by men whose duty it is to discover defects in pavements and prescribe repairs. Even from the standpoint of repair cost, such a system saves money. When cleaning is considered, as well as repairs, the saving of a patrol system is so great as to make any other system a luxury.

The bad pavement is the despair of the street cleaner. Every town has streets that ought to be called graveyards. There lie the remains of past paving failures, rutted, rough and unsightly to reproach the men who laid them. As a street cleaning superintendent my last word of advice to you is to tear such pavements up and build pavements in which you can take pride. Build for ease of traction, build for durability, but also build for sanitation. Build a pavement that can be washed and kept clean. Such a policy is not expensive. The real extravagance is to keep pavements on your streets that are a barrier to traffic, a breeding place for germs and a burden upon the street cleaning department to keep in a condition of half-way respectability.

In view of our experience and the economy of cleaning streets of one kind compared with that of another, as well as the difference in economy that is apparent to the man on the job, of a street out of repair and one in a maximum state for use, I wish to seriously submit for your consideration as to whether or not those who design, construct and select pavements, have not lamentably failed in measuring the economy of a pavement by excluding every consideration which is involved in keeping them in clean, sanitary condition, confining their consideration simply to cost of construction, maintenance and repair.

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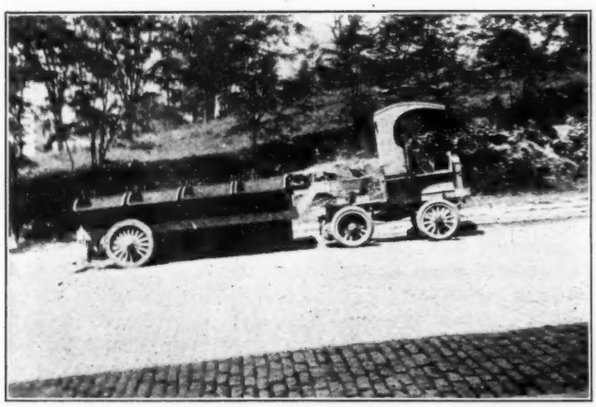
## Gasoline-Electric Tractors in New York Street Cleaning Service

For some time past the New York street cleaning department has been trying out various tractor and trailer combinations for the collection of ashes, garbage and street sweepings, as well as for mechanical sweeping and flushing of streets. The experience gained in this experimental work showed that while the electric tractor was highly desirable from the standpoint of operating simplicity, the mileage limitation imposed by the storage battery equipment was a handicap. Further, that because of the many stops in collection work (60 to 100 per hour), the gasoline tractor with gear



GAS-ELECTRIC TRACTOR *hauling garbage collection truck up steep grade on granite block pavement.*

transmission clutch, spark and throttle control was not only impractical but presented the disadvantages of greater complication with the resulting necessity for a higher class of drivers.

It has long been appreciated that the real work of street cleaning and flushing must be done at night, and the collection of refuse during the day. This calls for at least sixteen hours service in twenty-four.

A type of tractor which would be capable of practically continuous operation, and adaptable to either kind of service, was evidently necessary. A tractor equipped with a gasoline engine driving an electric generator, whose output could be used in motors driving the rear wheels was accordingly chosen as having the simplicity of control of an electric vehicle and the relatively large mileage capacity of straight gasoline equipment. This combination also presented the advantage of providing, in the most convenient form, energy for driving the auxiliary apparatus used in street sweeping and flushing.

Except for railway service, comparatively little development has been carried thru on vehicles driven in this way, and the problems involved in the design of the tractor were of a very complex nature.

A semi-technical description of twelve tractors which have been constructed by the General Vehicle Company, Inc., of Long Island City, for the department of street cleaning, city of New York, follows:

The tractor frame is built of structural shapes, amply reinforced and is carried on semi-elliptic springs of generous proportions. Wood bumpers, reinforced with steel, protect both front and rear ends.

The axles are both made of round alloy steel, and the wheels are carried on Timken roller bearings.

Two sets of brakes, both of the internal cam expanded band type, are provided, both for foot operation, one engaging drums on the rear wheels, and the other drums on the intermediate gear shafts.

The motors are suspended by links from extensions of the rear spring hangers, and by extensions of their cases which bear on the rear axle. The motors drive by spur gears to intermediate shafts, which carry pinions engaging with internal ring gears mounted on the rear wheels. The use of pressed fabric pinions on the motor shafts resulted in extremely quiet operation. The motors themselves are, except for the special cases, of the standard automobile type with ball bearings.

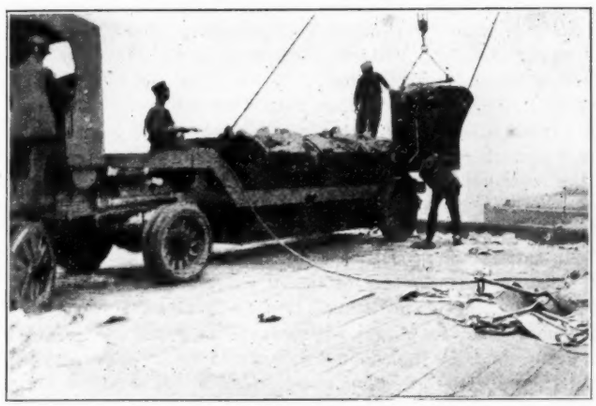
A consideration of the heaviest operating service, which will be when performing the work of street sweeping and flushing, showed that the power consumption over and above that necessary for propelling the tractor and sweeping and flushing trailer, would be about 15 h.p. Taking into consideration the probable mechanical and electrical losses, and the requirement for traction of approximately an equal amount, a 40-h.p. gasoline engine was thought to be a proper selection. The engine used in the tractors is a 4-cylinder Waukesha, cylinders cast in pairs with 4¾x6¾-inch cylinders. This is equipped for forced lubrication, has a zenith carburetor, dual ignition system with Bosch magneto, centrifugal water pump circulation thru a large Rome-Turney radiator built in an aluminum shell and supported directly on the frame without springs. A centrifugal governor maintains a rotative speed of 900 r.p.m., this latter being the rated speed of the electric generator.

The generator was built by the General Electric Co., and is rated at 15 k.w., 125 volts, 120 amperes at 900 r.p.m. The electric wiring is all carried in metal conduit, and controller, cut-out switch and ignition switch are placed in a sheet steel box beneath the driver's seat.

On account of it being necessary to operate close to the curb a great deal of the time, a right-hand drive was chosen, and the controller handle is also placed so as to be operated by the driver's right hand. In order to make it unnecessary for the driver to concern himself with anything other than the controller lever, brake pedals and steering wheel, a magnetic device for operating the carburetor throttle is provided to automatically open the throttle when the controller lever is moved in either direction from neutral. This is accomplished by the use of a solenoid of the plunger type which is connected by linkage to the throttle lever. The coil in the solenoid is connected in multiple across the generator terminals thru a contactor on the controller shaft, which is so arranged that a slight motion of the controller handle from neutral position in either direction will close the circuit, and automatically speed up the engine before the driving motors begin to draw current. A protecting resistance is automatically cut into the circuit by the plunger before it is entirely seated. The engine operates on fixed spark and the spark is automatically retarded when cranking by means of linkage actuated by the ratchet which the starting handle engages. The controllers are of unusually heavy construction for vehicle service and are arranged to give five speeds forward and two reverse. The driver's seat is protected by a cab.

A steering gear of the double screw and nut type with slightly raked steering post is provided, and provision has been made in the design of the front axle and steering knuckles for an unusually large turn of the wheels so as to

LIFTING WATER-TIGHT CANS *of refuse from garbage collection truck to discharge into scow. Gas-electric tractor at the left.*



give a small turning radius. The tractors were also built with the shortest possible wheelbase consistent with accommodating the trailers to be used with them in order to permit turning tractor and trailer in a narrow street. It was found possible to reduce the wheelbase to 72 inches and with the long refuse trailer in place it is possible to turn the tractor and trailer in a 30-foot street. Shadbolt fifth wheels are used on all the equipment so that any tractor can be quickly connected up with any of the trailers.

The total trailer load; that is, weight of trailer and material carried, is 20,000 pounds, for both collection and sweeping and flushing trailers. On test the tractors have shown a speed of about 8 miles an hour on the level and from 3 to 3½ miles per hour up a 6½ per cent. grade. These tests were made carrying load nearly 10 per cent. in excess of the rated load. In collection work each tractor and trailer will carry four men besides the driver who will supervise their work. In ordinary districts a crew of this size will be able to handle the work rapidly enough so that the tractor will be in operation more than it is standing. At the dumping dock the collected material, which is carried on the collection trailer in eight water-tight cans, will be lifted out and dumped by electric locomotive cranes, and it is expected that when these are in full operation the work will be handled very expeditiously.

The trailers to be used in the work of street sweeping and flushing will include a tank to carry 1,500 gallons of water, sprinkling and flushing nozzles and a rotary broom, also operated by electric motor. On the basis of tests which have been made on equipment performing these same functions, it is expected that great saving will be effected in this work also. When all the equipment is in service the department expects to be able to operate the tractors practically sixteen hours a day and it is needless to say that if this is done, a high standard of efficiency will be obtained.

## Hypochlorite or Chlorine Sterilization for Water Supply of Milwaukee

The remarkable decrease in the typhoid death rate during the past two years has proven conclusively the wisdom of treating our water supply continuously under proper supervision.

The typhoid death rate of 11.54 per 100,000 of population for the year 1913, which was the lowest in thirty-nine years, was still further reduced to 8.25 per 100,000 of population during 1914. The hypochlorite plant was in continuous operation during the year and the average efficiency was 96.56 per cent. of all bacteria destroyed.

While no difficulties were encountered in applying this method of treatment during the summer months, taste and odor were very perceptible on a number of occasions when the temperature of the water was below 38 degrees F., in spite of the amount of bleach having been reduced to 0.1 part available chlorine per million parts of water, or 2.3 pounds of bleach per million gallons of water. With a reduction in the quantity of bleach applied, a high efficiency of the plant could not be maintained, and fermentation in 10 c.c. of treated water occurred on quite a few days. To increase the quantity sufficiently to avoid fermentation would immediately follow with taste and odor and scores of complaints from consumers. Many consumers could not be convinced of the harmlessness of the treatment, and while the increase in the bacterial count warranted an increase in the quantity of bleach applied, the departmtent did not dare to do so in quantities sufficient to obtain satisfactory results. For these reasons the superintendent recommends the use of liquid chlorine in place of hypochlorite of lime. The use of liquid chlorine has been found very successful in plants where it is used for the treatment of water, and as it does not impart taste or odor and practically eliminates all labor costs, from a financial standpoint alone it is in the interest of the department to make the change.

## Municipal Asphalt Repair Plant of Washington, D. C.

The municipal asphalt repair plant of Washington, D. C., is operated almost entirely on mixture of old materials, taken from streets being resurfaced, only about 4 per cent. of its product being new material during the year 1914-15.

The average daily output during the 240 days the plant was operated was 725 cubic feet, which corresponds fairly with the experience of past years. The quality of the output is entirely satisfactory and the economy of the use of old material is marked. The old material as removed from the streets is hauled to the asphalt plant, and during the past year the crusher has been so operated that the material was laregly crushed as received, instead of being allowed to accumulate before crushing operations were begun. This has resulted in a marked reduction in the cost of crushing, which was 74 cents per cubic yard, including all overhead charges, as compared with $1.04, the analogous figure for the preceding year.

The crushed material is placed in the heating drum, with an admixture of a formulated amount of sand, stone screenings, and limestone dust, and heated to a prescribed temperature and then transferred to a mixing drum. Therein it is mixed with a charge of fresh asphaltic cement and thence transferred to the carts and taken to the street. The proportions of the various ingredients are constantly under observation, and slight variations therein are made from time to time, as observation indicates their necessity. This detail is a most important one, due to the fact that the old material, as received from the street, is not a constant product, while the resultant mixture to be replaced on the street should be approximately such.

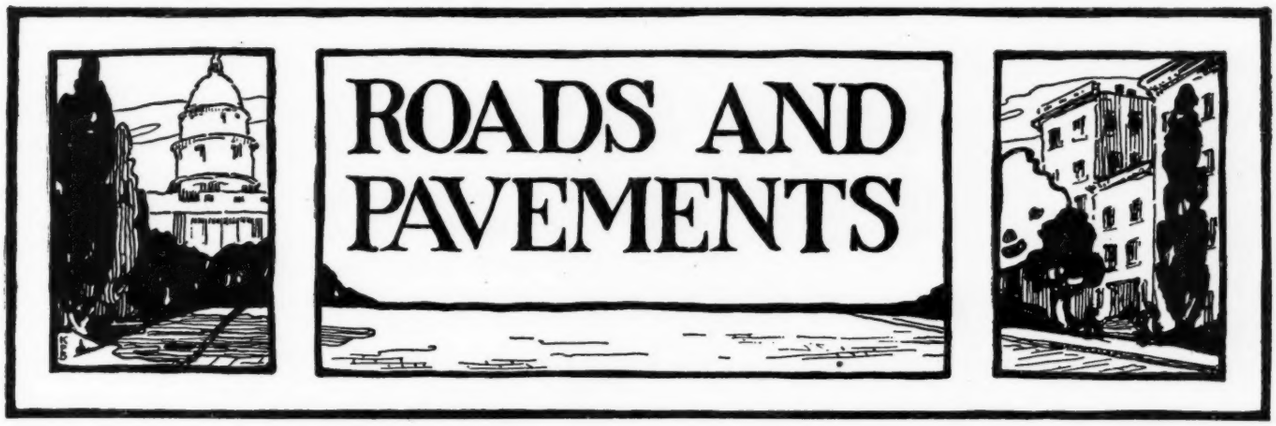
Sand cost $1.07 a cubic yard; asphalt cement, $15.50 a ton; limestone dust, $2.20 a ton; screenings, $1.53 a cubic yard. Fuel oil cost 7 and 3.45 cents a gallon; coal $3.68 a ton, and wood $5 a cord.

In operating the crusher ninety-nine days with 4,790 cubic yards output, labor and fuel cost 57.1 cents a cubic yard; maintenance, renewals and repairs, 7.8 cents; overhead charges, 9.3 cents, including interest on capital invested at )1½ per cent. and obsolenscence, five years life of plant, at 20 per cent., making the total cost of the crusher 74.2 cents per cubic yard of the product.

The asphalt plant cost was 5 cents per cubic foot; haul from plant to street, 4 cents; street labor, 11.6 cents; maintenance and repairs at plant and on street, 0.74 cents; sharpening tools, 0.5 cents; overhead charges, interest and depreciation, 0.9 cents; foreman and overseers, 3.5 cents; making the total cost 26.24 cents a cubic foot. New materials added cost as follows in averages per cubic foot of the mixture: 0.23 cubic feet sand, 0.92 cents; 0.06 cubic feet screenings, 0.34 cents; 2.1 pounds limestone dust, 0.25 cent; 3.66 pounds asphaltic cement, 2.82 cents, making the total material cost 6.13 cents per cubic foot. Adding the manufacturing and placing cost from above, 26.24 cents, makes the cost of the mixture 32.37 cents a cubic foot as laid in the street using old material.

Using the manufacturing and placing cost above, 26.24 cents, the cost of new asphalt top is computed at 40 cents a cubic foot in the municipal plant as compared with 47 cents, the price by contract for class b mixture. For class a the costs are 47.23 and 52 cents, respectively; for binder class b 34.6 and 39 cents, and for class a 37.6 and 41 cents, respectively.

The cost of asphalt repairs for the year distributed over the yardage of asphalt pavements not under contractors' guaranty averages 1.8 cents per square yard.




## Gravel Roads Notes

West Virginia has had such good success in working both state and county prisoners on the repair and reconstruction of roads during the past three years that they are now being used in the construction of reinforced concrete bridges for under and over grade crossings of highways and railroads.

It is proposed to Congress to pass a law prohibiting states from collecting an additional automobile registration fee from automobilists who have already paid fees and complied with the regulations governing automobiles and automobilists in their home states, thus making automobile traffic over state lines as free as other traffic is at present. This will eliminate some disagreeable features of interstate travel, especially in such cases as New Jersey, where there is a very plausible argument in favor of charging fees for foreign automobiles because of the large number of automobiles from the great cities on and near its borders which make full use of New Jersey roads, and under the proposed law would not be required to make a contribution to the upkeep of such roads.

The National Highways Association is publishing a series of maps of the principal transcontinental lines of highway proposed or located and under construction. The latest map is one of the Midland Trail, with branches from Washington and Richmond, Va., meeting in Charlottesville and running west thru Charleston, W. Va., Frankfort and Louisville, Ky., Vincennes, Ind., St. Louis and Kansas City, Mo., along the Union Pacific railroad to Denver, Colo., thence by several routes to Grand Junction, Colo., thence west thru Salt Lake City, and thence southwest thru Copper Falls and Tonopah, Nev., to Los Angeles, or to San Francisco. Its route thru Missouri is that of the National Old Trails road and thru part of Utah and Nevada is that of the Lincoln Highway.

The southern section of Market street, the principal mercantile thorofare of Chattanooga, Tenn., has just been paved with wooden blocks, which displace the old cobble stones. The Southern Paving and Construction Co., of Chattanooga, places the layer of concrete necessary to bring the old cobble stone pavement to even grade, and lays the pavement. This is the first wood block street in the city of any extent and costs $50,000.

On November 26, the board of county commissioners of Cook county, Ill., were the guests of the Associated Roads Organizations of Chicago and Cook County on the first annual inspection of state-aid roads laid in Cook county, Ill. The trip covered 110 miles of good and bad roads entirely within the limits of Cook sounty, except one short excursion into DuPage county to see the concrete pavement laid by the DuPage county board on Wheaton road, an extension of the Twelfth street concrete road of Cook county. In several towns along the way the citizens extended enthusiastic receptions to the county board and the good roads sentiment in Cook county sustained a remarkable impetus.

The trip was so arranged as to cover typical improved highways as well as some of the unimproved roads. The rainy weather which prevailed served to call forcibly to the attention of the commissioners the contrast between muddy, unimproved highways and the concrete roads built by state-aid.

Under the law as originally framed, the county was not permitted to build roads within village limits. The error of this was excellently shown on the Twelfth street road, where alternate good and bad stretches were encountered. The good stretches were those built under state-aid and the bad spots were unimproved stretches on the same road within village limits. There was a sigh of relief each time a good road was raeched. By an amendment to the Tice law of Illinois, the county is now empowered to pave the bad stretches thru villages with a population of 20,000 or less.

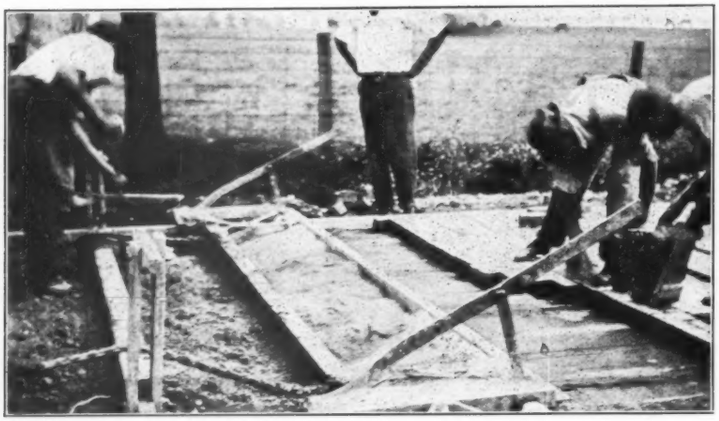
The seven-mile stretch of concrete road on Milwaukee avenue, one of the principal thorofares leading to Chicago and used largely by automobilists and truck farmers, was included in the trip. This is the longest continuous stretch of concrete highway in Illinois.

## Road Contracts Awarded by State of Ohio in Year 1914

| Type of Road | Miles | Total Cost | Average Cost Per Mile |
|---|---|---|---|
| Brick | 156.49 | $3,283,497.84 | $20,982.04 |
| Concrete | 120.54 | 1,714,956.51 | 14,227.28 |
| W. B. Macadam | 181.46 | 1,565,593.66 | 8,627.76 |
| Gravel Macadam | 4.38 | 36,639.50 | 8,365.18 |
| Bit. Macadam | 16.68 | 184,563.70 | 11,064.97 |
| Bituminous Surface, Treated Macadam | 7.46 | 56,244.50 | 7,509.28 |
| Glutrin Surface Treated Macadam | 2.00 | 15,430.00 | 7,715.00 |
| Grading | 6.05 | 20,392.24 | 3,370.62 |
| *Total* | 495.09 | $6,877,299.95 | |
| 5 Contracts for Bridge Structures | | 33,233.83 | |
| *Total Cost* | | | $6,910,583.78 |

## Monolithic Brick Pavements Successful in Illinois

Rodney L. Bell, engineer in the Illinois state highway department, states that the saving in cost of construction of monolithic brick paving over former methods is 10 to 15 cents a square yard. His principal reason for favoring the new method, however, is the entire absence of sand between the brick and consequent thoro grouting of joints and formation of a monolithic surface. He told the Northwestern Road Congress at Grand Rapids, Mich., that tentative experiments in



TEMPLATE *by which dry mortar mix is spread on green concrete base just in advance of brick laying.*

the abolition of the sand cushion had been made in Baltimore, Cleveland, the Pennsylvania new terminal in New York, Springfield, Mo., and elsewhere, so that the idea is not so new, altho the completeness of its working out in Illinois is an advance upon any previous construction.

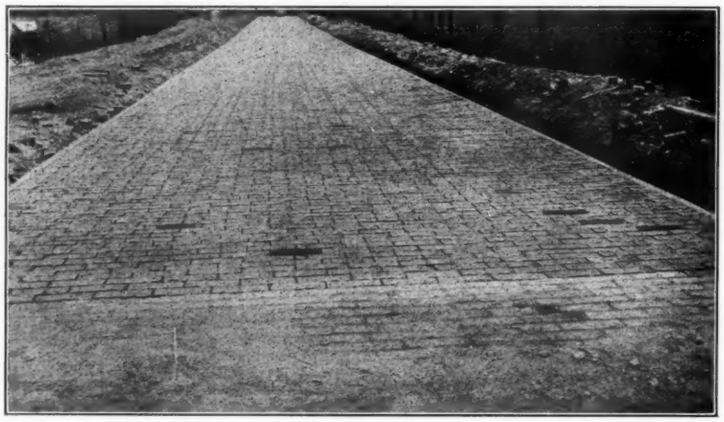
Cross expansion joints are not favored by the Illinois highway department, as they think such joints are destructive of brick road surfaces.

A brick pavement in Chrisman, Ill., laid in 1914, which blew up, showed that the sand had been forced up by the rolling of the brick at least half the 4-inch depth of the brick and had prevented the thoro filling of the joint with grout. The stress due to the expansion of the surface by the heat of the sun was thus concentrated so that the blowing up was the only thing the pavement could do.

In Illinois brick road construction the rough work on the sub-grade is done with traction engine and grader, the engine thoroly compacting the sub-grade The grade being dressed by hand, is further compacted by the 5-ton, self-propelled roller, which hauls the materials. Steel forms are set true to line and grade, 8 inches in depth and 12 feet long. The concrete base is 4 inches thick and the brick are 4 inches in depth, making, when completed, an 8-inch monolithic pavement. Steel forms, while not absolutely essential, are a great convenience in this type of construction, according to Mr. Bell.

The concrete for the base is 1:6 mixture of cement and washed gravel. The gravel tests very close to 50 per cent. thru a ¼-inch square mesh. The base for the state-aid work now under contract will be one part cement, three and one-half parts fine aggregate and six parts coarse aggregate. Enough water is used so that the concrete is of a quaky consistency, but will not flow. It is found that an excess of water causes trouble in keeping the brick up to a true surface.

In order to get approximately the right thickness of concrete before cutting it with the template, a small wooden guide is used. The steel template used is necessary in order to secure accurate results on this type of work. This template, shown in one of the accompanying photographs, is made up of a 6-inch I-beam in front and a 6-inch channel behind. They are placed 2 feet apart and supported by four rollers, one at each end of each member. The rear edge of the template is set exactly 4 inches below the top of the forms and the front edge is set 4 3/16 inches below the top of the form. The hopper-like space between the two edges is kept filled with a dry mix consisting of one part cement to five parts sand. The



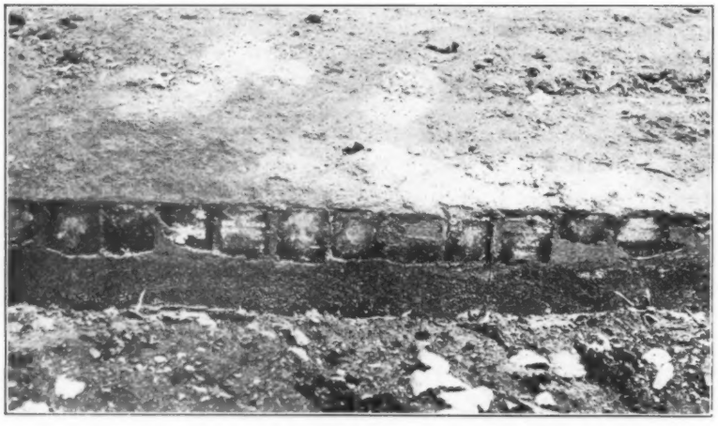
COMPLETED PAVEMENT *in foreground and the next day's work just beyond, ready to receive the joint grouting.*

template is drawn forward, the front edge cuts the concrete 3/16 inch below grade and a thin film of dry mortar is spread over the concrete, filling all the little depressions in the surface. Theoretically, the dry mortar coat should be exactly 3/16 inch in thickness. In reality, it does not have any noticeable thickness, but is sufficient to give a perfectly smooth surface for the brick.

It is essential to have the brick rolled carefully and thoroly and the grout applied in the most approved manner, so as to fill the joints completely and combine bricks horizontally into a monolithic mass in order that the combination with the foundation thru the mortar cushion may retain its monolithic character also.

The accompanying photographs show the double template smoothing off the concrete and the dry mortar cushion on top of it; the edge of the pavement and the thoro bonding of foundation and bricks together, and the surface of the finished pavement.

GROUT FILLER *is shown extending to bottom of brick, thus bonding foundation and brick surface into a solid monolith.*



# MISCELLANEOUS

## This New City Wants Everything

It has been a good many years, even in the fast-growing Southwest, since a town of nearly 2,000 population has been confronted at one time with practically every problem of engineering that is necessary in the building of a city. Ringling, Okla., is an oil-field town, but it is more than that. It was incorporated early in November. J. L. Hamon, vice president and general manager of the Oklahoma, New Mexico & Pacific Railway Company, who laid out the townsite, had it platted and offered its lots for sale, of course dictated where business houses should be erected, and he had the streets graded. The town grew to a population of 1,000 in a few months, without any form of municipal government.

Late in November the first town officials were elected. Frank L. Ketch, claim agent for the Oklahoma, New Mexico & Pacific Railway Company, who has had charge of the sale of town lots, was elected president of the board of trustees, which makes him, in effect, mayor of the town. Mr. Ketch has had experience in municipal government, having been a member of the city council in Lawton, Okla., for several years, and he organized the board and set it to work in a business-like manner.

It now becomes the duty of the board to provide the necessary public utilities, and it is a serious one, for Ringling is likely to have several thousand population long after the cream has been taken from the oil business.

Ringling is far out on the prairies of a long-used cattle country, 30 miles from Ardmore, 30 miles from Waurikax, and 40 miles from Lindsay, which gives it a trade territory of approximately 300 square miles in which are developing agriculture, livestock raising and asphaltum mining, as well as oil and gas and other minerals. In the rain belt of Oklahoma and in a region where 90 per cent. of the land may be cultivated, there was not left in the state so large a section of country untouched by a railroad or in which a modern town had not been built.

J. L. Hamon is organizing a gas and electric company. Gas from one of his wells, which has a daily capacity of 52,000,000 cubic feet, is already in town.

A water works system will be a necessity at once. Quite a number of permanent buildings have been constructed, but many lot owners are awaiting the installation of a water system before expending much money in building. The town officials also plan to put in a sewer system as soon as revenues will permit it. Asphaltum mines are located only a few miles northwest of the town, and street paving is likely to be considered within a year.

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## Calendar of Meetings of Associations

The Indiana Engineering Society and the Indiana Water Supply Association will hold their annual conventions together at the Claypool Hotel, Indianapolis, on February 2, 3, 4 and 5, 1916. On February 4 the two associations will hold joint sessions and a joint banquet. The exhibit feature of the joint conventions will be of more than usual interest. Charles Brossmann, 1616 Merchants Bank building, Indianapolis, is secretary of the Indiana Engineering Society, and Dr. W. S. King, State Board of Health, of the Water Supply Association.

The American Wood Preservers' Association will meet at Hotel Sherman, Chicago, Ill., January 18, 19 and 20, 1916. The sessions are open to those interested. The effects of the war on the supply and use of preservatives will be shown. Special committees of experts will make elaborate reports on preservations, specifications for timber, wood block paving, etc.

The Illinois section of the American Water Works Association will meet at the University of Illinois, Champaign-Urbana, January 25 to 27. Edward Bartow, secretary, Urbana, Ill.

The Illinois Society of Engineers and Surveyors will meet at the University of Illinois, Champaign-Urbana, January 26-28. Joint sessions with the Illinois section of the American Water Works Association will be held January 26 and 27.

The next convention of the American Road Builders' Association will be held in Pittsburg, Pa., February 28 to March 3, 1916. The usual Good Roads show will be held in Mechanical Hall, Du Quesne Way. The American Highway Association has been invited to hold its convention at the same time and place without expense to it and to arrange programs which will co-operate, also to continue the plan, the two associations to alternate in control of the conventions and shows. E. L. Powers, secretary, 150 Nassau street, New York.

The second national conference on concrete road building will be held in Chicago in connection with the cement show, February 15 to 18, 1916. The work of the conference is in the charge of seventeen sub-committees with definitely assigned groups of subjects. J. P. Beck, Chicago, Ill., is secretary.

The American Concrete Institute will meet in Chicago in connection with the cement show February 16-18. John M. Goodell, secretary, Philadelphia, Pa.

The American Concrete Pipe Association will meet in Chicago during the cement show February 17 and 18.

The South Atlantic Road Congress meets January 17 to 20 to prepare for a road building campaign in its territory.

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## Personal Notes

John A. Giles has been promoted from city engineer to commissioner of public works at Binghamton, N. Y. He has been city engineer since 1908.

Irwin S. Osborn, designer and constructor of the garbage

reduction plants at Columbus, O., and Toronto, Ont., has opened an office in the Rose building, Cleveland, O., with U. D. Allen, formerly building commissioner of Cleveland, for practice as consulting engineers.

Joseph A. Rourke, formerly assistant engineer of public works, has been put in charge of the high pressure water service, of Boston, Mass.

J. Herbert Shedd, one of the earliest civil engineers in practice in the United States, opening an office in his own name in 1859 after three years previous experience, has died in Woonsocket, R. I., at the age of 81. He has been connected with engineering work in Providence, R. I., as water works engineer, city engineer, harbor commissioner and consulting engineer ever since the year 1866.

James Mapes Dodge, chairman of the board of the Link-Belt Company, died on October 4. He was among the first to join in the development of the chain business with W. D. Ewart, the inventor of link belting, and has been identified with it ever since, the technical development of the company being his special idea. This idea as carried beyond the highly specialized expert study of the materials and methods used in improving the product of the factories into the design of plants for handling both raw and finished products of factories of all kinds, thus vastly improving methods and instituting great economies at the same time that business was developed for the belt manufacturing company. One of the most important of the problems solved was that of handling coal, the cost of which he reduced from 30 or 40 cents a ton per ton round trip in and out of storage to less than 5 cents.

Henry Welles Durham, formerly chief division engineer of highways of the Boro of Manhattan, New York, and now a consulting engineer in that city, has been appointed county engineer of Bergen County, New Jersey. His work in this same line has included also sewer reconstruction on the New York subway work, resident engineer in charge of municipal engineering work on the Pacific slope of the Panama Canal Zone, particularly for Panama City. He will reside in Bergen County, but will retain his office for consulting practice at 366 Fifth avenue, New York.

O. S. Beyer, Jr., of Horton, Kan., has been appointed first assistant in the engineering experiment station in the department of railway engineering of the University of Illinois and his investigations will be conducted mainly in the locomotive laboratory, which has recently received a locomotive from the Illinois Central Railway, taken from regular service, repaired and presented to the university.

C. C. Blair, of the Bessemer Limestone Co., Youngstown, O., is this year's president of the National Paving Brick Manufacturers' Association.

George S. Iredell, formerly city engineer of Austin, Tex., has opened an office in the Littlefield building, in the same city, for practice as a civil and electrical engineer. He is now making bridge plans for the city.

G. M. Crawford has recently assumed charge of the drag line department of the Pawling & Harnischfeger Co., Milwaukee, Wis. Mr. Crawford, in years past, has been responsible for the development of many practical features of drag line excavators and may be said to be responsible for the application of electrical power in this field.

## New Publications

"The Cost of Pumping Water" is the title of a collection of graphical charts with accompanying explanatory text issued by the DeLaval Steam Turbine Co., of Trenton, N. J. The object of the publication is to facilitate computation of the overall economy of different types of steam pumping units, having given the cost of fuel, steam pressure, rate of interest, cost of apparatus and other variables. The first chart shows the number of B.t.u. represented by each pound of steam for various combinations of superheat, steam pressure and feed water temperature. The second chart gives the cost of 1,000 pounds of steam and the cost of a million B.t.u.'s in the steam from the cost of coal per ton, the heat value of the coal and the boiler efficiency. The third diagram shows the relation existing between the average cost of steam-turbine-driven centrifugal pumping units and the head pumped against. The fourth diagram shows the amount of money to be set aside yearly for sinking fund, to cover depreciation for different terms of life and rates of interest. The fifth diagram is the well-known Mollier steam chart, supplemented by a convenient scale by means of which B.t.u. available per pound between given limits, the resulting velocity of steam in feet per second and the corresponding duty in foot pounds per 1,000 pounds of steam, and the pounds of steam per h. p.-hour may be read off directly. The sixth diagram is an alinement chart for determining the resistance of pipes to flow of water. Three scales represent gallons per minute, diameter of pipe in inches, and loss of head in feet per 1,000 ft. of pipe. A straight edge laid across points corresponding to known figures on two of the scales shows the third variable by intersection with the remaining scale. At the end of the publication is a list of representative municipal installations of DeLaval steam-turbine-driven centrifugal pumps, from which it is to be observed that units of this type have been installed for capacities as large as 100,000,000 gallons per day and heads as great as 334 ft., and have developed duties exceeding 150,000,000 ft. lbs. per 1,000 lbs. of steam. It is also pointed out that because of the low first cost of apparatus, foundations and buildings inherent in this type of pump, the total cost of pumping water is greatly reduced as compared with the much larger, heavier and more expensive triple-expansion reciprocating pumping engines, in spite of the somewhat higher duty exhibited by the latter. Copies of the publication are offered gratis to those interested.

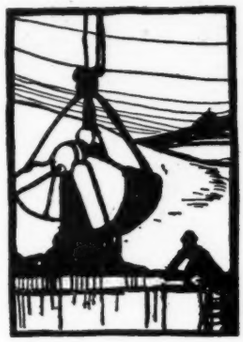
There has just been published for the Watuppa Ponds and Quequechan River Commission, of Fall River, Mass., the report of the consulting engineers, Fay, Spofford & Thorndike, of Boston. Including the commission's report, this forms a volume of more than 200 pages, with copious illustrations from both photographs and drawings, as well as a pocket of maps showing different phases of the proposed development. Some of the engineering features are unique, including the three-story conduit for carrying hot discharge and cool condensing water for the mills, besides surface drainage. A common cooling pond is designed for all the mills along the river. The civic problems met include a new sewerage system, the abatement of nuisances along the river, the conservation and control of water, and a number of other items having unusual features. It is estimated that the proposed work will cost nearly three million dollars, of which almost one-third will be paid for from the sale of 146 acres of land to be reclaimed along both banks of the river.

## Publications Received

Annual Report of the Engineering Department of Salt Lake City, for 1914, Sylvester Q. Cannon, city engineer, Richard P. Morris, commissioner of streets and public improvements. A report of the largest year's work yet done in the city, amounting to $1,435,835 of work actually done during the year and $921,726 of contracts partly completed.

Proceedings of the third annual meeting of the Montana Institute of Municipal Engineers, C. C. Widener, secretary, Bozeman, Mont.

"Some Problems of Street Paving in Large Cities" is the subject of a paper before the Municipal Engineers of the City of New York by Henry Welles Durham, consulting engineer, New York, and reproduced in a separate pamphlet.



# MACHINERY AND SUPPLIES

## Use of Portable Air Compressors

The city of Minneapolis, Minn., in enlarging the capacity of its water works system by the addition of 7½ miles of trunk pipe lines, made extensive use of a portable gasoline-driven air-compressor for furnishing air power on the work.

This compressor, as illustrated, has a capacity of 105 cubic feet of air per minute at 100 pounds pressure. The air is distributed along the trench thru 1,000 feet of 2-inch pipe, having outlets spaced at suitable intervals for hose connections. Armored air hose is run from the main to the air tools. Boyer air hammers are used for riveting and calking the pipe. The lower rivets are driven on the inside and the upper rivets on the outside. The reaming is done by a Little Giant air drill. Three riveting hammers, one calking hammer and one air motor are used simultaneously on the work. Sections of the distribution pipe and the compressor are moved ahead at intervals, and the work progresses without interruption.

The pipe is of the Lock Bar type, and is made up in sections 30 feet in length. This kind of pipe was adopted for economy in thickness of metal and carrying capacity. The pipe for the 48-inch distribution lines is 5/16 inch thick. The pipe for the 54-inch force main is 5/16 and ⅜ inch thick, depending on the working head on the pipe in the upper and lower portions.

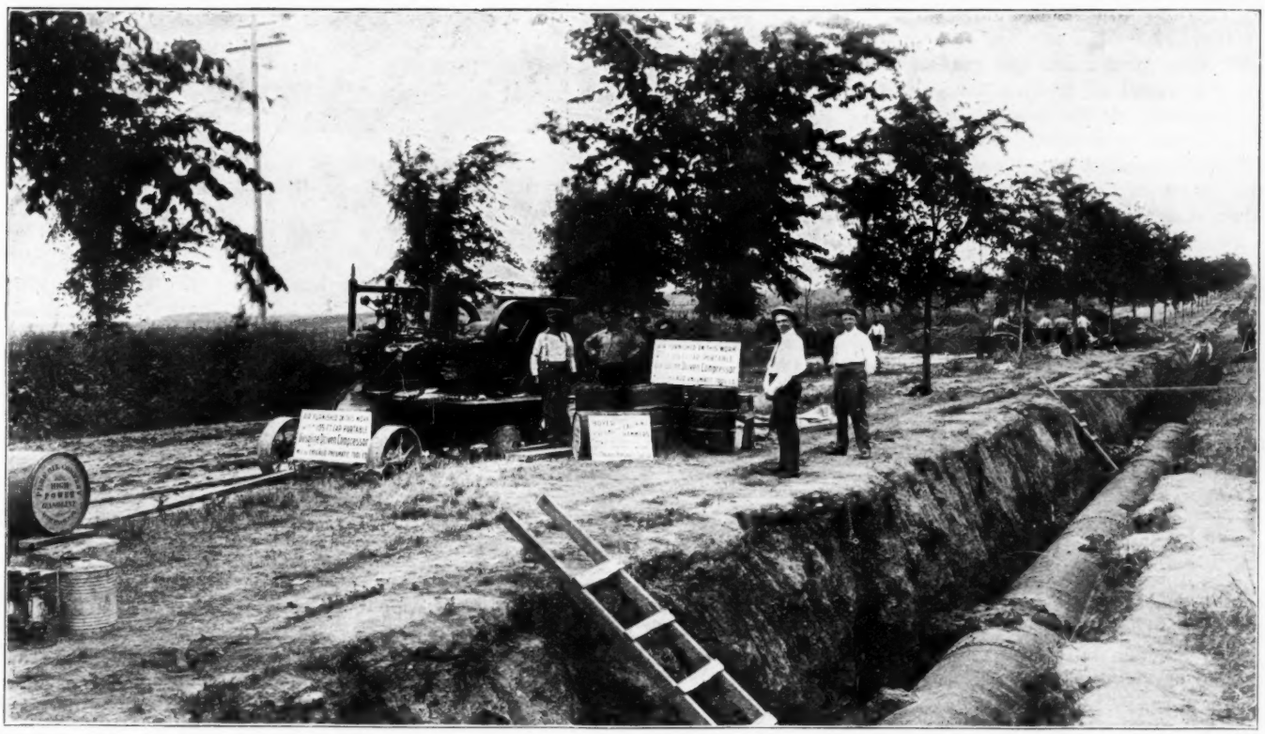
The pipe is made up in truncated sections and assembled in the trench by telescoping. The joint is made up by a single row of rivets and the plates calked inside and outside. The rivet holes are centered by drifting and boltitng when the pipe is laid, and trued up by reaming. The rivets are driven and joints calked by the use of compressed air.

CHICAGO'S PNEUMATIC *Portable Gasoline Driven Compressor used in construction of filtration plant by city of Minneapolis, Minn.*

## Free Distribution of "Roads" Book

The illustrated booklet, entitled "Roads; Their Influence Upon Economic and Social Conditions," is being distributed in large quantities by township, county and state highway engineers and superintendents.

This book, which is furnished for free distribution by The Garford Motor Truck Co., Lima, O., and is written by Mr. S. M. Williams, sales manager of this concern, is liberally illustrated, and, unlike the great majority of books published by industrial concerns, contains no advertising matter. Hundreds



of thousands of copies of this book will be distributed during the winter months. Officials who desire copies should address the publishers, giving number of copies wanted. The Garford Company will, on request, mail these booklets direct to names on furnished lists.

M. Griffin O'Neil & Sons, hydraulic and sanitary engineers, Dallas, Tex., in writing Mr. Williams relative to this "Roads" book, state:

"We are in receipt of your letter of August 21, addressed to our Mr. M. Griffin O'Neil, enclosing literature relative to your illustrated article upon 'Roads; Their Influence Upon Economic and Social Conditions.' You are to be congratulated upon this article. It should do much to stimulate the sentiment for good roads.

"For the past fifteen years our attention has been devoted largely to the design and construction of municipal improvements. We are beginning to turn our attention more than ever to good roads and street paving.

"To work up the sentiment for good roads to the point where the citizens will demand them, we have decided to use such literature as your illustrated article on roads, supplemented by picture films showing the advantages of good roads, and the disadvantages of the bad road.

"It is our intention, after having the films made, to take them to the counties that need roads and can afford to build them, and there show them in the towns and thruout the county in such meeting places as we can get the people to attend, such as the country school houses. Of course, we will have talks and discussions of roads in conjunction with the showing of the films and also put literature in the hands of the people that will tend to create a sentiment for good roads.

"We would like to have permission to reproduce some of the views and statements in your article, and would appreciate any suggestions or information as to the films and literature referred to."

Mr. J. L. Kelly, president Good Roads Association, The Dalles, Oregon, writes:

"Wasco county, Oregon, is a large county, 65 miles across, and it claims 1,100 miles of roads. The products of the county are largely fruit and grain, and many farmers are quite a long distance from market, and the county is hilly.

"There is a movement on at this time to bond the county for $262,500 for the purpose of improving the roads. If this bond issue carries and the roads are improved, it will also probably result in combination school districts so as to enable the country districts to have graded schools, the pupils to be carried to and from the school in school wagons.

"Your pamphlet mentioned above is a very creditable one, and applies in a peculiar way to conditions in this county. I think that two thousand of these pamphlets might be used to good advantage in this county at this time. It would enable us to educate the people up to the voting of the bonds and the improvement of the roads. If you can send me the number of pamphlets mentioned, I will see that they reach the voters of this county. If you cannot send that amount, I will make use of any number you can supply.

"Our campaign for the bond issue is now on and if these pamphlets and cuts are to be used, I should receive them at the earliest possible date in order to get the same in the hands of the people."

## Steel Telescopic Sewer Forms

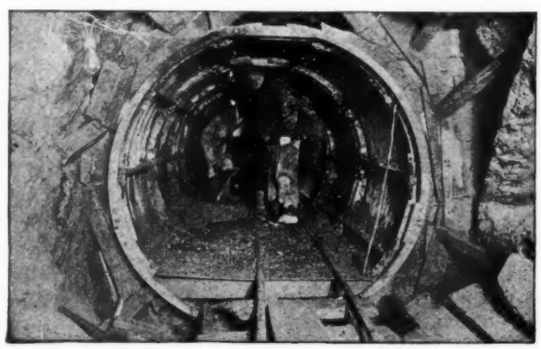
The illustrations show a new type of telescopic sewer form, with several distinctive features, which has been used on the Catskill aqueduct, comprising over 70 miles of tunnels; Astoria tunnel, Sandpatch tunnel, Louisville and Nashville railroad tunnels in Tennessee and Kentucky, and the New York and Boston subways.

BLAW *half-round sewer forms being shifted. Insert —Blaw telescopic full-round sewer form.*



On a San Antonio, Tex., contract, 175 feet of these forms were collapsed, moved forward and reset in seven hours, this while concreting was going on on the balance of the forms used on this contract. This type of form is being used on four contracts in San Antonio.

The form is made in quadrants, the invert, or bottom sections being built with angles which form a track on which the small steel and wood carriage runs. After the forms have been erected, they are collapsed by removing bolts at the base thru the angles, and the wedge-shaped wood filler piece in the lower right-hand side of the structure. The wood filler piece is withdrawn and the four segments are placed one on top of another on the small carriage which runs on the invert of



BLAW *tunnel form on 76-inch full round tunnel; James Hanreddy, Chicago, Ill., Contractor.*



the forms. The carriage is then pushed thru the forms which are in posititon, and which are being concreted. A turnbuckle is used to line up the forms when they are being concreted. The manufacturers are the Blaw Steel Construction Co., Pittsburg, Pa.

## New Ford Meter Testing Machine

The new model Ford meter testing machine, known as the Baby Ford, was primarily designed for the requirements of the smaller water companies and departments. This model is provided with a 1-inch Mueller inverted key stop valve at inlet end and outlet side is equipped with the Ford calibrated strip, by means of which any size flow, from 1/32 to 1 inch in ten steps may be passed.

The Fairbanks Company manufacture a special scale, having in addition to the regular beam a special water meter beam by means of which the error of the meter under test

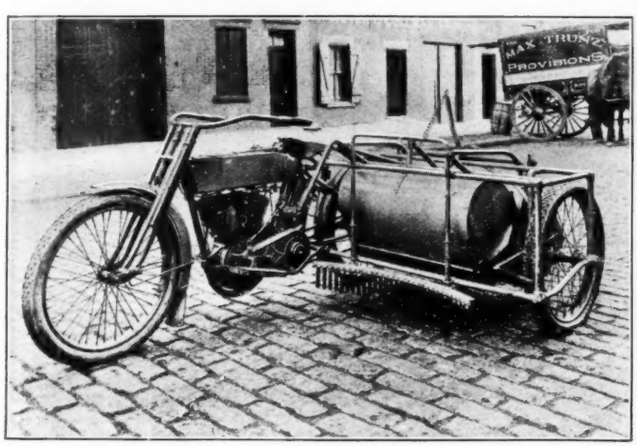
may be read directly in per cent., plus or minus. With the model testing machine now used, it is recommended that a tank of following dimensions be used: 12 cubic feet capacity, 22 by 56 inches, made of No. 10 and No. 12 boiler iron, and having a 1½-inch quick-opening throttle valve as outlet.

The Ford Type 4 testing plant is so arranged that one 1-inch and three ⅝ or ¾-inch meters may be tested simultaneously and with the same water, or any may be tested separately. This plant consists of a cast iron table 16 inches by 5 feet 4 inches supported by two heavy cast iron pedestals. Securely bolted to this table are four meter yokes, the first yoke being fitted to take any 1-inch standard water meter, the next three any ⅝-inch or any ¾-inch standard water meter. The inlet port is controlled by a 1-inch Mueller inverted core valve, as is also the 1-inch by-pass extending up from the outlet end of the 1-inch yoke and over the other yokes to the discharge point of the plant. The regular ¾-inch outlet valve is of the same make and pattern and is above the outlet end of the fourth yoke. At the outlet end of the last yoke is installed a vertical bronze plate 1¼-inches wide. This plate has seven different sized and accurately calibrated holes thru it from 1/32 inch to ¾ inch in diameter. By a very simple device this strip can be placed at any pre-determined place so that the flow of water will be compelled to pass thru the desired hole in the plate. By a partial turn of two hand wheels any desired change can be obtained. This plant is equipped with two 200-pound gages, four brass tubes or idlers to use in their respective yokes when that particular unit is not in use, connections and appliances necessary to take any standard ⅝, ¾ or 1-inch meter. The connections used in these yokes are adaptations of the standard Ford connections.

## Motorcycle Street Sweeper

We are illustrating a motorcycle street sweeper as designed by the Harley-Davidson Mfg. Co., Milwaukee, at the left side of which is attached the refuse pick-up apparatus which carries a rotary broom 30 inches long and 16 inches in diameter. Just forward of the broom is placed a swinging dust pan for collecting the dust as it is swept up. The pan may be dumped by means of a hand lever while the machine is in operation. Mud clots and other hardened refuse adhering to the pavement are removed by a metal-toothed rake mounted in front of the pan.

The steel brush in front is held firmly to the pavement by two springs which have sufficient movement to permit of the brush being used in loosening street refuse even where granite, sandstone or other block pavement is used and the surface is uneven. The refuse is lifted into a receptacle by a rotary brush with practically no dust being raised, the brush being almost entirely enclosed.




The driving of the rotary brush is thru a gear connected with the motorcycle transmission from the motor thru the rear wheel. The raising and lowering of the brush is controlled easily by the operator with a lever convenient to his left hand.

## Hose Connection for Power Street Flusher

A hose connection on a power street flusher is a very convenient adjunct, as is shown by the accompanying photograph of a Studebaker street flusher in use in Boone, Iowa, for spraying trees. A machine with this attachment can be used as

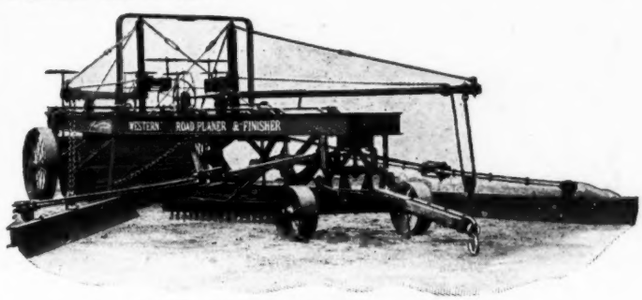
well for sprinkling lawns and grass in parks and outlying districts where the water supply is not within reach and for street sprinkling, throwing a spray which covers a wide road at one passing. The hose can also be used on emergency for extinguishing a fire in a building, in grass or in forest.

## Combined Road Scarifier, Planer and Roller

The application of gasoline, oil and steam tractors for road building purposes has had the effect of revolutionizing the machinery employed for road building and maintenance work.

For several years municipalities, cities, counties and townships and also road contractors, have been purchasing high power traction engines and motor trucks capable of handling road-making machines of much greater capacity than had before been built.

To meet the demand for a heavy road machine for construction work, in conjunction with high-powered tractors, the Western Wheeled Scraper Co., Aurora, Ill., are marketing a new machine known as the Western road planer and finisher, a machine which combines the properties of a road scarifier, a planer and a roller.




WESTERN ROAD PLANER AND FINISHER.

The toggle principle is employed for opening and closing the blades and also for holding them at their various working angles. The front center and rear of each blade can be raised or depressed independently. The extreme width of cut that can be made is 30 feet, but it can be decreased to 15 feet by the turning of two hand wheels. The blades when folded for transportation rest on supports located above the front wheels of the machine so that there is nothing to prevent short turning. The weight of the rear end of the machine can be transferred to the face of the rolls as the machine passes along, thus increasing the roller pressure at will. The machine requires between 25 and 40-horse power to operate.

## Tractors in Municipal Haulage

The city of Cincinnati, Ohio, recently decided to look into the merits of the gasoline tractor for municipal hauling. Among other things, it determined to find out how much tractors could haul, whether several trailers could be handled conveniently, whether the tractor engine was equal to the task of hauling heavy tonnage up an 8 per cent. grade and whether the tractor brakes could be depended upon to hold back the combined weight of several heavily loaded trailers down an 8 per cent. grade.

When preparations for the experiment were completed, a rugged-looking Knox tractor was brought on the scene. The place chosen for the test was Gilbert Hill, a 7,000-foot stretch, with a mean grade of 6.2 per cent.; maximum grade, 8.3 per cent.; minimum, 1.8 per cent. The surface of the street was granite block.

Six trailers were used, ordinary municipal type dumping wagons, as shown in the illustrations. The city authorities had specified that there should be no load whatever on the rear wheels of the tractor and the demonstration was accordingly made with the entire load rolling on steel wheels. The six trailers were loaded with mud and the total weight of this pay load, as shown by the city scales, was 38,500 pounds, making it an interesting matter for speculation as to whether the big "gasoline horse" would be able to haul this unusual load, weighing approximately twenty tons, to the summit of the hill.

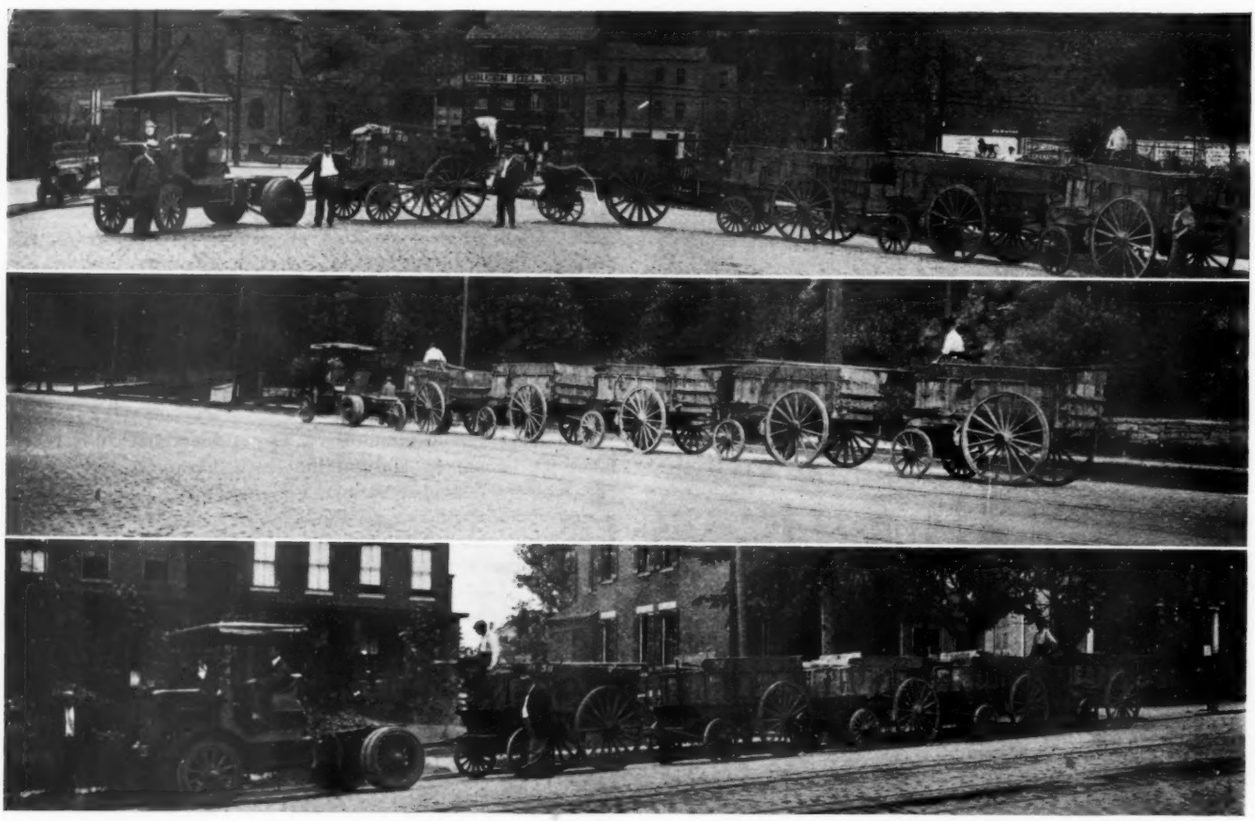
The train was started at the bottom of the hill, made the ascent, turned at the top of the hill without stopping and with all the wagons tracking perfectly, and returned to the foot of the hill. In coming down the grade, the entire load was held back by the tractor only, the brakes on the trailers not being set at any time.

The tractor was brought down the entire length of this 7,000-foot grade in low gear. Two complete stops were made at the steepest part of the hill to demonstrate the ability of the tractor to hold back the load.

The weights of the trailers used in the demonstration, as shown by the city scales, were as follows:

| | |
|---|---|
| Where five wagons were used: | |
| First two wagons | 11,600 pounds |
| Second two wagons | 18,000 pounds |
| Fifth wagon | 8,950 pounds |
| Total | 38,550 pounds |
| Where six wagons were used: | |
| First two wagons | 11,600 pounds |
| Second two wagons | 18,000 pounds |
| Third two wagons | 16,070 pounds |
| Total | 45,670 pounds |

The weights in this demonstration were 25 per cent. in excess of the loads to be hauled by the city of Cincinnati in



VIEWS SHOWING KNOX TRACTOR. (1) *Making complete turn with five loaded trailers;* (2) *making 6½ per cent. grade with 38,550-pound load;* (3) *descending 7.8 per cent. grade at 3 miles per hour, tractor brakes holding back entire 38,550-pound load.*

actual service, and Knox equipment has, therefore, been purchased.

Another interesting instance of the successful working out of the tractor and trailer method is the hauling done by a Knox tractor owned by the city of Springfield, Mass. The illustrations show hot asphalt being hauled from Springfield to Indian Orchard—a distance of seven miles. As in case of Cincinnati, the trailer was of the regulation municipal bottom-dumping type. The first trailer carried 8 tons and each of the other two contained 2½ tons, making a total pay load of 13 tons. No difficulty was experienced in negotiating Armory street hill—a 6 per cent. grade—and the average running time between loading point and destination was said by the driver to be one hour.

The illustrations show one obvious advantage of the tractor and trailer for this type of road construction work—the ease with which the load may be dumped and spread in any desired position. Other advantages claimed for the tractor and trailer method are that the bulk of the paying load rolls on steel-shod wheels, that the power-plant may be transferred from one type of work to another merely by interchanging trailers, and that the trailer methed makes possible the highway transportation of such materials as steel girders, long lumber timbers and other commodities which cannot be hauled successfully by gasoline power in any other way.

## Two-Wheel Eagle Trailers

We are illustrating a motor truck pulling two-wheel trailers whose actual draw bar pull shows exceedingly light draft. Eight of these 3-yard trailers, which are made by the Eagle Wagon Works, Auburn, N. Y., follow one another or track when turning at almost right angles.

These carts have steel axles with straight roller bearings, on wheel hubs, solid and strong everywhere. The chain device for raising doors has an equalizer which brings one door up and then laps the other under it, making a tight bottom for crushed stone, gravel or sand. The draw bar is braced with a saw-tooth brace which does away with pins and levers, to find and hold the draw bar in the center. This saw-tooth brace is the hounds (so to speak) of the pole.

There are two different ends to these cars. One end is called the flexible end. This is also the end to be fastened to the tractor where more than one cart is used. This same end takes care of all the up-and-down of the load or all the pull.

It also takes care of the perfect alinement of the train when it is reversed in direction. There are no pins to shift when the direction of the train is changed.

This flexible end of these carts with the saw-tooth brace, cares for all the adjustments for uneven ground or road bed, also cares for the necessary adjustment when one cart is in a hollow and the other on a knoll, and finally makes the train reversible without pins or levers. This device on the flexible end, as well as the equalizer bar on the ridged end, have applications for patents pending.

## Shallow Excavation by Steam Shovels

Steam shovels are being advantageously used on shallow excavation, for street and road construction in many sections of the country.

The city of Minneapolis, Minn., is using three revolving shovels on street surface excavation work preparatory to paving. On one of these jobs, on which a very hard, dense clay, mixed with boulders, was encountered, a Thew revolving shovel was used with the following results:

LABOR.

| | | |
|---|---|---|
| One engineer | $6.00 | |
| One fireman | 2.50 | |
| Two laborers at $2.50 | 5.00 | |
| Total labor cost | | $13.50 |

FUEL.

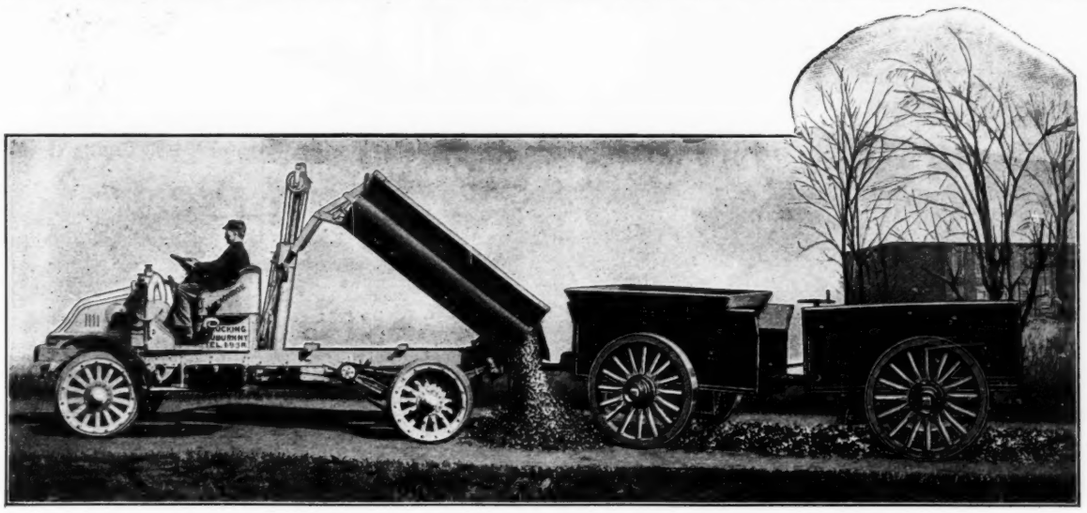
| | | |
|---|---|---|
| Coal, ½ ton at $6 | $3.00 | |
| Oil, grease and waste | 0.15 | |
| Repairs and overhead charges | 1.05 | |
| Total fuel cost | | 4.20 |
| Total cost of excavating 250 cubic yards | | $17.70 |
| Cost of excavation 1 cu. yd. $17.70/250 | | 0.07 |

The above table, giving average cost of excavation for an eight-hour day, shows 7 cents to be the average cost of 1 cubic yard of excavated material in the wagons, ready for haulage to the dump. An inspection of the data shows that an average hourly excavation of 31¼ cubic yards was attained.

ADVANTAGES OF CATERPILLAR MOUNTING.

On an excavating contract awarded to George Maxfield, Toledo, O., and sublet to the Robert Grace Contracting Co., various road changes were encountered, principally the building of approaches where county roads cross the new line of the Chesapeake & Ohio Northern.

This work is about four miles from Waverly, O., and includes a fill of about 15,000 cubic yards. Mr. Maxfield is using six 2-yard teams with an 18-B Bucyrus, mounted, as stated, on caterpillars and carrying a ⅞-yard dipper. At the present



MOVING SHOVEL *to the work. S. B. Van Wagenen, Inc., Contractors.*



time the shovel is obtaining the material for the fills from the railroad grade near by. The caterpillar method of mounting was adopted because of the large number of shallow cuts and the consequent necessity of frequent and otherwise slow and costly moves.

DIFFICULT MATERIALS ENCOUNTERED.

Instead of using scraper methods in construction of macadam roads near Lake Placid, N. Y., S. B. Van Wagenen, Inc., contractors, are using a 14-B Bucyrus shovel with a ⅝-yard dipper. According to the statement of Mr. C. C. Donahue, material handled is, as a whole, difficult to excavate, consisting for the most part of boulders and hardpan with a very little earth mixed in. The cut carried has run from two to eight feet and the shovel has averaged about 300 cubic yards per ten-hour day, which is considered good under the circumstances. On this work, two 5-ton White trucks, used in the hauling of stone from the crushing plant, have replaced five teams formerly engaged in the same work. On another section of this same contract a White truck is also used. The service of the White truck on this contract is most interesting. Besides the duty above mentioned three trips a day are being made with coal averaging 5.7 tons per load. In addition, it is used for carrying men and supplies to and from the work. Mr. Marshall estimates that it saves them $15 per day, replacing eight two-horse wagons on hills. It has not been used for taking the excavated material from the shovel, but there are many places where its use for this purpose would be very economical.



SHOVEL IN SHALLOW EXCAVATION. *Clinton Contracting Co., Contractors.*

SHALLOW STREET GRADING IN NEW JERSEY.

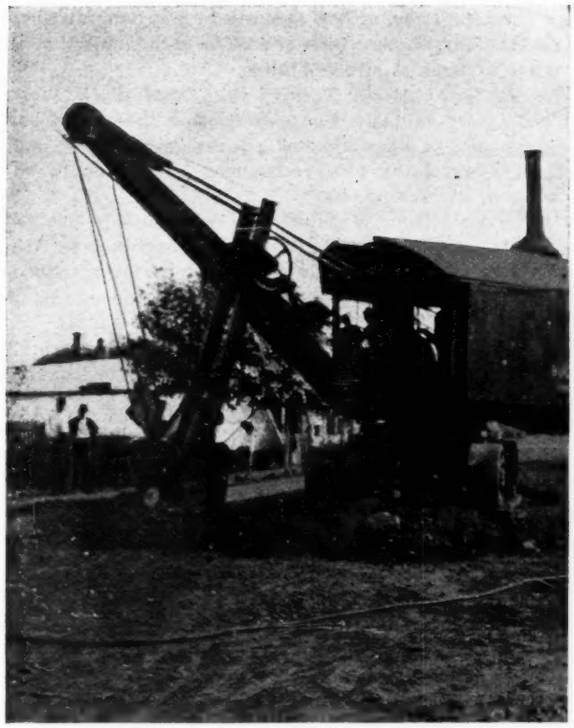
We are illustrating, also, an unusually shallow piece of street grading recently completed in West New York, New Jersey. The work was handled by the Clinton Contracting Company of West Hoboken, N. J., John Murphy, secretary; Joseph Murphy, general manager.

In the past, contractors have been somewhat skeptical as to the feasibility of doing a piece of grading as shallow as this with a revolving shovel, and doing it in an economical manner. Mr. Murphy used an 18-B Bucyrus revolving shovel equipped with a ⅞-yard dipper with an outfit of dump wagons.

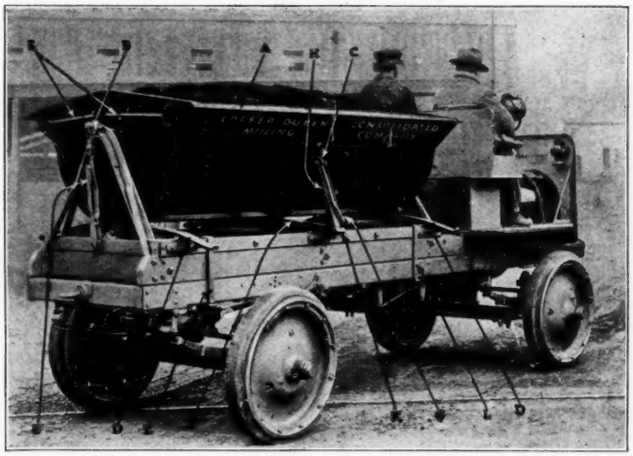
The material handled was hard-pan and macadam. The dump was about 300 feet from the shovel. The street averaged 30 feet in width, and the depth of cutting ran between two and eight inches, or an average of six inches. Under these conditions the shovel averaged about 150 cubic yards per ten-hour day. About a ton of hard coal was used per day.

REQUIREMENTS IN MOUNTAINOUS DISTRICTS.

State and county road construction invariably requires a succession of moderate cuts ranging from a few inches to a few feet, in order to bring the road to grade. Here a smooth level floor is essential, especially if paving is to follow, or the result will be an uneven settling giving the roadway a wavy surface. Time and again the ability of the revolving shovel to live up to these requirements and to do the job economically, has been proved. Shallow cuts as low as two to eight inches are being dug economically. Many roads are now being cut thru rough, mountainous country. Here the revolving shovel is proving its worth; towit: the state road work in California and the county road construction in the Adirondacks in New York. The revolving shovel not only has sufficient power to dig boulders and rock formation and overcast on side hill work, but is sufficiently portable to be moved over rough country with comparative ease. We know of one case on state road work in Pennsylvania where, unassisted, a steam shovel propelled itself up a grade of 30 per cent. An illustration shows a steam shovel on State road construction near Baltimore, Md., for the Maryland State Roads Commission which was handled by Barber & Bonner, Inc., of New York. The shovel, equipped with a ⅝-yard dipper, moved in



SHOVEL IN SHALLOW EXCAVATION. *Maryland State Roads Commission. Barker & Bonner, Inc., N. Y., Contractors.*



LEE DUMP BODY, *Showing Body Secured in Position.*

LEE DUMP BODY *May be Dumped and Rolled Back With One Motion.*

all about 30,000 cubic yards of material, which was handled by locomotive and cars, wagons and automobile trucks, as conditions demanded. Mr. H. O. Barker, president, writes as follows in reference to this work: "Considerable shallow cutting from 12 to 20 inches was done with the shovel on this contract and the digging was performed in a most economical manner. No difficulties were experienced during the entire work and in every way the shovel proved most satisfactory."

## Lee Dump Body on Quad

The photographs herewith show the operation of the Lee two-way side-dump body as used on the Jeffery Quad. The body is secured in position by catch, a similar catch in the front, an eccentric stop and a similar stop at the other side, as well as by the three rails on which it rolls in dumping. Each of these rails slopes away from the center line of the chassis to each side and terminates in a hook which acts as one of the final pivoting points when the body is being dumped.

The act of dumping is performed as follows: The handle in the middle of the body is raised, thus releasing the eccentric stop. The support is now free to move outward, so the operator now pulls the handle toward him and allows the support to hang downward from the hinge. This operation takes only a second or two. Then the operator grasps the handle and pulls it sideways, one way or the other, thus releasing the catch and a similar catch in front, to which it is connected by a longitudinal rod. This, also, takes but a second or two. The body is now ready to be dumped, which is done by pulling out one of the handles and pressing on it easily until the body rolls over on the rails, the distance thru which it rolls being governed by the length of the restraining chains under the body. Usually the operator dumps and rolls back the body with the same motion, altho in these pictures he did not do so. Instead, he walked to the other end of the body in order not to obstruct the view of the camera. The support and the catch are now quickly replaced, both front and rear catches being operated at the same time by either the handle or the similar one at the front of the body.

In a series of tests at the Jeffery factory, it was proved that the average driver could jump down from his seat, dump the load, replace and secure the body and return to his seat ready for driving off, in half a minute. An expert can do it in from twenty to twenty-five seconds.

The Quad was originally designed and built to replace the four-mule team in the United States army. The term "quad" is an abbreviation of "quadruple drive." The power of the motor on this truck is applied to all four wheels. Also, to aid in maneuvering in tight places and to make the rear wheels track with the front wheels, the steering device works on both front and rear wheels. Quick stopping is provided by brakes on all four wheels and on the drive-shaft.

The results of this advanced construction is a truck which easily negotiates mud, sand, gravel and difficult grades which are impassable to the ordinary type of rear-wheel-drive trucks.

LEE DUMP BODY, *Showing Three Rails on Which Body Rolls When Dumping.*



The success of the truck in the United States army was so immediate and sensational that there quickly sprung up a big demand in the contracting field.

## Trade Publications

The annual report for 1914 of the Mexican Petroleum Co., Ltd., of Delaware and its subsidiaries, the Mexican Petroleum Co. (Cal.) and Huasteca Petroleum Co., has been received. In addition to the financial report showing a large profit for the year it gives a historical sketch of the development of the company's oil lands near Tampico, Mexico, which include more than half the oil lands yet located in Mexico. In addition to works at Tampico, the company have large refineries at New Orleans and were developing plants at other localities in the United States when the war conditions in Mexico made it impossible to get their product out as rapidly as desired and delays progress upon plans on which work had been begun.

The Chamber of Commerce of Vandalia, Ill., is distributing copies of the resolutions passed by it deploring the delay in settlement by the insurance companies of the fire loss of the Ford Mfg. Co., in March, 1913, the insurance amounting to $647,000.

The Universal matchless sewage spraying nozzle is shown with results of comparative tests in a circular of the Snow & Petrelli Mfg. Co., New Haven, Conn.

The Troy Wagon Works Co., Troy, O., sends a strikingly illustrated circular of the Troy Ajax dump wagon.

Kissel-Kar trucks are shown in full detail in a handsomely illustrated booklet issued by the Kissel Motor Car Co., Hartford, Wis.

Reinforced concrete bridges of Luten design in large numbers and in both black and colored plates are shown in a sumptuous book issued by Daniel B. Luten, designing and consulting engineer, Indianapolis, Ind.

The American Rolling Mill Co., Middletown, O., issues a variety of booklets and circulars on Armco iron, rust-resisting products and their uses in defeating rust, which makes very interesting reading.

The Clip Bar Mfg. Co., Philadelphia, Pa., have a galvanized curb guard, which they describe in a recent circular.

The Owen Bucket Co., Cleveland, O., describe their products in a booklet under the title, "The Business End of the Rig."

"Constant Current Transformers for Mazda Street Lighting Systems" and "Novalux Street Lighting Units for Mazda Series Lamps" are the titles of two booklets of the General Electric Co., Schenectady, N. Y., which are of value in connection with the newer systems of street lighting.

The De Laval Steam Turbine Co., Trenton, N. J., have produced a very valuable, 8-page booklet on the cost of pumping water with a diagram and separate steam scale and a chart for determining pipe resistances, which should be in the hands of every engineer.

The De La Vergne Machine Co., New York, in their bulletin No. 142, give the details of their oil engine, type DH.

Richmond screw anchors in concrete dock construction are shown in a circular of the Richmond Screw Anchor Co., New York.

The Blaw forms in sewer, tunnel, dam, wall and building work are illustrated in a circular of the Blaw Steel Construction Co., Pittsburgh, Pa.

Engineers' Bulletins 1, 2, 3 and 4 of the California Glazed Cement Pipe Co., Los Angeles, Cal., give experience with and results of tests of concrete pipe.

A table published by H. W. Clark Co., Mattoon, Ill., compares water, labor and cost for testing by single meter outfit and by their 3 and 6-meter, multiple testers.

The Turbine Sewer Machine Renovating Co., Milwaukee, Wis., have a number of interesting circulars descriptive of their apparatus for cleaning sewers and water pipes and giving the results in many places where it nas been used, which are well worth sending for.

A paper on asphalt, its history, manufacture and uses read before the Brooklyn Engineers' Club by Charles Ekstrand, M. E., pays special attention to Montezuma asphalt and is reprinted by Warner-Quinlan Asphalt Co., New York.

The advantages of using one of the various styles of Studebaker dump wagons are briefly and clearly set forth in a mailing circular of the Studebaker Corporation, South Bend, Ind., No. A 895.

The Clark meter coupling yoke for use in setting water meters in Clark meter boxes is shown in operation and fully described in a circular of H. W. Clark Company, Mattoon, Ill.

The Chicago Pneumatic Tool Company are now distributing their Bulletin No. 216, covering their Hummer self-rotating type hammer drills, which are made in three sizes, known as the A-66, B-66 and C-66 drills, suitable for drilling 6, 8 and 12-foot holes, respectively. Among the important features which the manufacturers have incorporated in their drill is that of the rotation of the steel being entirely independent of the hammer piston, eliminating the use of ratchet or pawl parts which is the common means used in other drills. This means a much more rapid drilling machine, as the piston is free to deliver the full force of its blow upon the drill steel without losing a part of its power through the necessity of rotating the steel as well. Another important feature of the Hummer drill is the valve which consists of a standard commercial hardened steel ball ordinarily used for ball bearings. It is three-quarters of an inch in diameter and weighs a trifle over an ounce. Its travel between its seats in the valve chest is only one-eighth of an inch. It is perfect in its action, practically indestructible and ideally simple as compared with other rock drills mechanisms. For further details of this drill and bulletin, address the Chicago Pneumatic Tool Company, 1010 Fisher Building, Chicago, Ill.

The Atlantic Refining Co., of Philadelphia, has reprinted the paper before the Pan-American Road Congress in Oakland, Cal., by Wm. D. Uhler, chief engineer of the Pennsylvania State Highway Department, on resurfacing of old roads, supplementing it with an illustrated description of resurfacing and surface-treating 1,200 miles of road in four months at minimum cost. It will be sent on request and is well worth careful study as giving excellent instruction on road maintenance.